This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

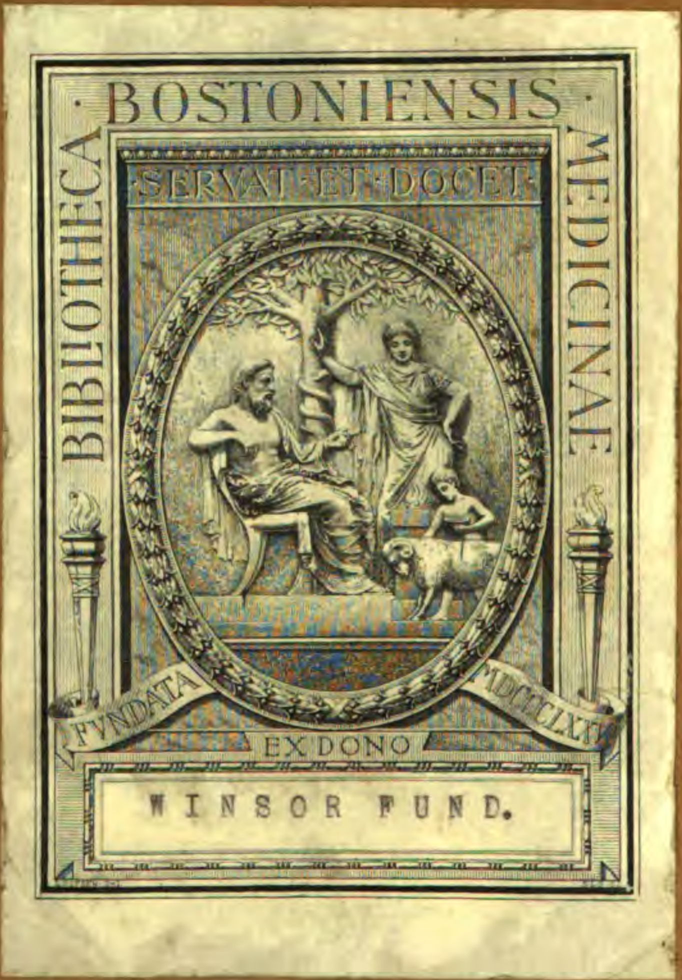
+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

17. A. 84



BIBLIOTHECA · BOSTONIENSIS · MEDICINAE
SERVAT · ET · DOCET
FUNDATA MDCCCLXXV
EX DONO
WINSOR FUND.

GENITO-URINARY SURGER

AND

VENEREAL DISEASES

BY

J. WILLIAM WHITE, M.D.

JOHN RHEA BARTON PROFESSOR OF SURGERY, UNIVERSITY OF PENNSYLVANIA

AND

EDWARD MARTIN, M.D.

PROFESSOR OF CLINICAL SURGERY, UNIVERSITY OF PENNSYLVANIA

Illustrated with Three Hundred Engravings and Fourteen
Colored Plates

SEVENTH EDITION

PHILADELPHIA AND LONDON
J. B. LIPPINCOTT COMPANY

5812

Copyright, 1897, by J. B. Lippincott Company

Copyright, 1900, by J. B. Lippincott Company

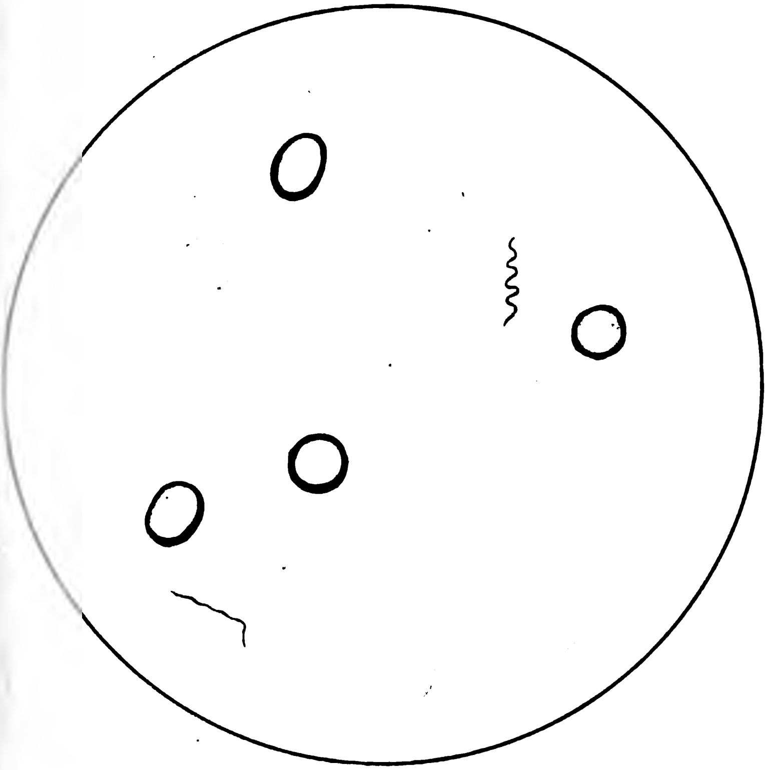
Copyright, 1902, by J. B. Lippincott Company

Copyright, 1905, by J. B. Lippincott Company

Copyright, 1906, by J. B. Lippincott Company

BOSTON MEDICAL
FEB 27 1907
LIBRARY.

ELECTROTYPED AND PRINTED BY J. B. LIPPINCOTT COMPANY, PHILADELPHIA, U. S. A.



Spirocheta pallida, the lightly stained organisms. Those stained with the darker stain are the *Spirocheta refringens* which are found in conditions other than syphilis. *Spirocheta pallida* is about 7 microns in length and varies from an immeasurable thinness to .5 of a micron in width. Its curves vary in number from 3 to 12, and it is extremely motile. The ends are distinctly pointed. This is demonstrable in enlarged glands, chancres, mucous patches, and flat condylomata, and has apparently been successfully inoculated upon the chimpanzee, though not in pure culture. It is extremely difficult to see in the fresh state and is refractory to staining even after prolonged contact with the dye. The best results have been obtained with Giemsa's azure-eosin mixture applied from one to twenty-four hours. The material to be examined is spread upon a cover-glass or slide, fixed in absolute alcohol for ten to twenty minutes, and the stain is then applied. It does not stain by Gram's method.

PREFACE TO THE SIXTH EDITION.

THE sixth edition of Genito-Urinary Surgery and Venereal Diseases has been revised in accordance with the latest teaching and practice of those most skilled in this branch of surgery. This has involved a study of current literature and a selection from it of such facts and procedures as have been proven worthy of general acceptance. Though the technique of the genito-urinary specialist has not been revolutionized in the last two years, it has in many respects been greatly improved. It has been our purpose to embody in this text-book all these improvements. It has seemed desirable to insert many new illustrations, and in some cases, notably in discussing prostatic hypertrophy, to rewrite some sections. We have endeavored to improve the book without enlarging it, and to make the teaching still more clear, direct, and practical.

PREFACE TO THE FIFTH EDITION.

In this fifth edition of Genito-Urinary Surgery we have carefully avoided an attempt to epitomize current literature, and have thus omitted methods of examination and treatment which have been accepted with approval by some practitioners and specialists. We have added to the text only such practical modern procedures as our own experience and judgment have shown to be of distinct value.

PREFACE TO THE FIRST EDITION.

In the preparation of this work we have endeavored to present clearly and with sufficient detail the generally accepted teachings of the day in regard to the pathology, symptomatology, diagnosis, and treatment of syphilis and genito-urinary diseases.

We have exercised the author's right of choice in estimating the comparative value of various methods of treatment, and have given chiefly those which our experience has led us to prefer, though alternative methods are usually mentioned. As it was our wish to make this book one of practical use to the physician, much space has been devoted to symptomatology, diagnosis, and treatment. The pathological alterations characteristic of the diseases and injuries described have been briefly outlined, avoiding discussion of questions still unsettled. Historical considerations have been abbreviated as much as possible, and references have been omitted, though proper credit has been given for special methods or teachings.

Emphasis has been laid upon genito-urinary antisepsis and the details of operative and manipulative technique, since thorough understanding of these matters must form the foundation for all good work in genito-urinary surgery.

The modern methods of examination of the various portions of the urinary and genital systems have been described with fulness, since only upon familiarity with them can exact diagnosis and scientific therapeutics be based.

We have included an exceptionally comprehensive study of the changes in the urine and its constituents produced by disease, a subject so intimately connected with the specialty to which this work is devoted as to deserve much more attention than it usually receives in surgical text-books.

While we have freely discussed established facts relating to the recognition or treatment of disease or injury, and important theories bearing on questions of surgical therapeutics, we have tried to avoid the confusion which is apt to result from the effort to be encyclopædic. Our views have been put in such form as to be of practical use to the general practitioner and the medical student, since we feel that our experience as hospital surgeons and as teachers during a number of years has familiarized us with their needs.

In the sections on Stricture of the Urethra and Treatment of Syphilis we have used portions of the articles on those subjects contributed by Dr. White to the volumes on Genito-Urinary Diseases and Syphilology of Morrow's System of Genito-Urinary Diseases, Syphilology, and Dermatology.

We must also express our thanks to Dr. G. H. Fox for placing at our disposal his admirable collection of photographs, to Messrs. Charles Lentz & Sons, of Philadelphia, for the illustrations of surgical instruments contained in the volume, to Mr. Joseph McCreery for his aid in the correction of the proofs, to Mr. Samuel Macmeney for much kindness in seeing the book through the press, and to Mr. G. E. H. Weaver for preparation of the index.

J. WILLIAM WHITE.
EDWARD MARTIN.

PHILADELPHIA, January, 1897.

CONTENTS.

CHAPTER I

DISEASES AND INJURIES OF THE PENIS

PAGE

Anatomy of the Penis—Anomalies of the Penis—Anomalies of the Prepuce—Narrowing of the Preputial Orifice—Phimosis—Circumcision—Paraphimosis—Shortness of the Frænum.—**Injuries of the Penis**—Contusion—Wounds of the Penis—Fracture of the Penis—Dislocation of the Penis.—**Inflammatory Affections of the Penis**—Acute Inflammation of the Penis—Chronic Inflammation of the Erectile Tissue—Inflammatory Lymphangitis — Phlebitis — Balanitis and Balanoposthitis — Herpes Progenitalis.—**Chancroid**—The Clinical Aspects of Chancroid—Complications of Chancroid—Treatment of Chancroid—Treatment of the Complications of Chancroid.—**Tumors of the Penis**—Cyst, Fibroma, Angioma, etc.—Lymphangioma or Elephantiasis—Verrucæ, or Papillomata—Horny Growths of the Penis—Malignant Disease—Partial Amputation of the Penis—Amputation of the Entire Penis.. 1–67

CHAPTER II

INJURIES AND DISEASES OF THE URETHRA

Anatomy of the Urethra—Malformations of the Urethra—Hypospadia—Epispadia.—**Injuries of the Urethra**—Lacerated and Contused Wounds—Rupture of the Urethra.—**Foreign Bodies in the Urethra.**—**Urethral Calculi** 68–101

CHAPTER III

AFFECTIONS CHARACTERIZED BY URETHRAL DISCHARGE

Urethrorrhœa—Urethritis.—**Traumatic Urethritis**—Irritative Urethritis—Eruptive Urethritis—Mechanical Urethritis—Cancer of the Urethra—Concomitant Urethritis—Specific Urethritis—Syphilitic Urethritis—Chancroidal Urethritis—Tubercular Urethritis—Typhoidal Urethritis—Influenzal Urethritis—Pneumococcic Urethritis—Diphtheritic Urethritis.—**Gonorrhoea**—Typical Acute Gonorrhœa of the Male Urethra—Treatment of Acute Gonorrhœa in the Male—Systematic Treatment of Acute Gonorrhœa—Subacute or Catarrhal Gonorrhœa.—**Chronic Gonorrhoea**—Chronic Anterior Urethritis—Chronic Posterior Urethritis 102–167

CHAPTER IV

GONORRHŒA IN WOMEN

PAGE

Frequency of the Disease—Seat of Infection—Contagion—Symptoms—Diagnosis.—**Urethritis**—Acute Urethritis—Chronic Urethritis—Folliculitis.—**Vulvitis.**—**Bartholinitis**—Acute Bartholinitis—Chronic Bartholinitis.—**Metritis**—Acute Metritis—Chronic Metritis—Gonorrhœal Salpingitis and Oöphoritis—Perimetritis.—**Vaginitis.**—**Gonorrhoea in Children**—Male Children—Female Children—Catarrhal Vulvo-Vaginitis—Gonorrhœal Vulvo-Vaginitis 168–183

CHAPTER V

COMPLICATIONS OF GONORRHŒA

Balanitis and Balanoposthitis—Phimosis—Paraphimosis—Lymphangitis—Lymphadenitis, or Bubo—Follicular and Periurethral Abscess—Prostatitis—Vesiculitis—Epididymitis.—**Extragenital and Systemic Gonorrhoea**—Cystitis—Ureteritis, Pyelitis, and Nephritis—Gonorrhœa of the Rectum.—**Gonorrhoea of the Eye**—Gonorrhœal Conjunctivitis—Rheumatic Gonorrhœal Ophthalmia.—**Gonorrhoeal Rheumatism**—Arthritis—Tenosynovitis—Phlebitis 184–202

CHAPTER VI

STRICTURE OF THE URETHRA

Inflammatory Stricture—Spasmodic Stricture—Organic Stricture—Clinical Forms of Stricture—Location of Stricture—Changes in the Urethra.—**Symptoms of Stricture**—Subjective Symptoms—Objective Symptoms—Diagnosis.—**Results of Stricture**—Extravasation of Urine—Effect on Bladder—Ureters—Kidneys—Prognosis of Stricture.—**Treatment of Organic Stricture**—Gradual Dilatation—Cleansing the Urethra—Passing the Sound—Strictures of Small Calibre—Strictures of Small Calibre permeable only to Filiform Bougies.—**Urethrotomy**—Internal Urethrotomy—Indications for Performance of Internal Urethrotomy—Internal Urethrotomy from before Backward—Internal Urethrotomy from behind Forward—External Perineal Urethrotomy—External Perineal Urethrotomy with a Guide, or Syme's Operation—General Indication for External Urethrotomy—Combined Internal and External Urethrotomy—Perineal Section—Drainage after External Urethrotomy and Perineal Section—Miscellaneous Methods—Summary of Treatment.—**Stricture of the Female Urethra** 203–257

CHAPTER VII

URETHRAL FEVER, ETC.

Urethral Fever—Acute Urinary Fever—Chronic Urinary Fever.—**Fistula of the Urethra**—Urethro-Rectal Fistulæ—Urethro-Perineo-Scrotal Fistula—Urethro-Penile Fistula.—**Urethral Pouches.**—**Urethral Neoplasms**—Diseases of Cowper's Glands—Cowperitis—Cysts of Cowper's Glands—Cancer of Cowper's Glands.—**Urethroscopy**—Examination—Appearance of the Urethra.—**The Care of Urethral Instruments**... 258–284

CHAPTER VIII

THE GENERAL SYMPTOMATOLOGY OF DISEASES OF THE URINARY TRACT—EXAMINATION OF THE URINE

PAGE

Pain—The Character and Intensity of the Pain—The Region of the Pain—The Relation of the Pain to the Act of Micturition—Frequency of Urination—Alterations in the Stream—Suppression of Urine—Retention of Urine—The Effects of Retention—Retention due to Paresis or Incoördination of the Bladder Muscles—Retention from Congestion or Acute Inflammation—Retention from Blocking of the Urethra or Vesical Neck.—**Retention from Prostatic Enlargement**—Symptoms—Diagnosis—Treatment—Incomplete Retention.—**Retention from Stricture**—Treatment—Retention from Traumatism.—**Incontinence of Urine**—Incontinence without Lesions of the Urinary Tract—Incontinence in Children—Diagnosis—Treatment—Incontinence with Lesions of the Urinary Tract—Hæmaturia—Treatment of Hæmaturia—Examination of the Urine—Alterations in the Quantity of Urine—Alterations in the Specific Gravity—Alterations in Color—Alterations in Reaction—Quantitative Alterations of Normal Constituents.—**Abnormal Substances in the Urine**—Serum-Albumin, etc.—Hæmaturia—Hæmoglobinuria—Carbohydrates, etc.—Bacteriuria—Pneumaturia.—**The Sediments in the Urine**—Blood, Pus, Casts, etc.—Technique of Examination of the Urine for the Usual Pathological Constituents.................. 285–366

CHAPTER IX

CYSTOSCOPY — EXAMINATION OF URINE FROM EACH KIDNEY SEPARATELY — RENAL CAPABILITY—SURGICAL TREATMENT OF NEPHRITIS

Cystoscopes—Method of Using the Cystoscope—Cystoscopic Diagnosis—Cystoscopic Appearances—Errors to be avoided in Cystoscopy—Cystoscopic Diagnosis of Vesical Tumors—Examination of the Urine from each Kidney separately—Massage of the Kidneys—Ureteral Catheterization—Segregation of the Urine—Determination of Renal Capability—Surgical Treatment in the Presence of Renal Insufficiency—Surgical Treatment of Nephritis.. 367–386

CHAPTER X

INJURIES AND DISEASES OF THE BLADDER

Anatomy.—**Malformations and Malposition of the Bladder**—Multiple Bladder—Complete Absence of the Bladder—Exstrophy—Treatment—Patent Urachus—Hypertrophy of the Bladder—Atrophy of the Bladder—Atony of the Bladder—Wounds, Contusion, and Rupture of the Bladder—Wounds of the Bladder—Complications of Wounds of the Bladder—Contusion of the Bladder—Rupture of the Bladder...... 387–411

CHAPTER XI

CYSTITIS—VESICAL TUBERCULOSIS—VESICAL SYPHILIS—VESICAL FISTULA

Cystitis—Classification—Etiology—Superficial or Catarrhal Cystitis—Interstitial Cystitis—Membranous Cystitis—Gangrenous Cystitis—Pericystitis — Symptoms of Cystitis — Diagnosis — Prognosis — Treatment.

PAGE

—**Perivesical Inflammation**—Perivesical Abscess.—**Tuberculosis of the Bladder**—Etiology—Pathological Anatomy—Symptoms—Diagnosis—Prognosis—Treatment.—**Syphilis of the Bladder**—Fistula of the Bladder—Symptoms—Diagnosis—Treatment 412–439

CHAPTER XII

CALCULUS OF THE BLADDER—TUMORS OF THE BLADDER

Vesical Calculus—Uric Acid Calculi—Urate Calculi—Phosphatic Calculi—Calcium Oxalate Calculi—Calcium Carbonate Calculi—Cystin Calculi—Etiology of Calculi—Symptoms—Diagnosis—Prognosis—Prophylaxis—Treatment.—**Litholapaxy**—Perineal Litholapaxy—Litholapaxy in Children—Contra-Indications to Litholapaxy—Complications of Litholapaxy.—**Lithotomy**—Perineal Lithotomy—Lateral Lithotomy—After-Treatment of Perineal Lithotomy Cases—Median Lithotomy—Bilateral Lithotomy—Medio-Bilateral Lithotomy—Suprapubic Lithotomy—After-Treatment of Suprapubic Lithotomy Cases—Complications and Sequelæ of Suprapubic Cystotomy—Treatment of Vesical Calculi in Women.—**Foreign Bodies in the Bladder.—Tumors of the Bladder.**—Papilloma—Myxoma—Fibroma—Myoma—Sarcoma—Carcinoma—Diagnosis—Treatment—Operative Treatment—Extirpation of the Bladder—Cystic Tumors of the Bladder—Varicose Veins of the Bladder—Paravesical Tumors 440–503

CHAPTER XIII

DISEASES AND INJURIES OF THE URETERS

Anatomy—Anomalies—Wounds and Rupture of the Ureters—Treatment—Ureteritis—Stricture of the Ureter—Treatment—Calculus of the Ureter—Symptoms—Diagnosis—Prognosis—Treatment—Fistula of the Ureter—Tuberculosis of the Ureter—Tumors of the Ureter—Prolapse of the Ureter 504–523

CHAPTER XIV

INJURIES AND DISEASES OF THE KIDNEYS

Surgical Anatomy—Anomalies of the Kidney—Floating Kidney—Movable Kidney—Pathology—Symptoms—Diagnosis—Prognosis—Treatment.—**Injuries to the Kidney**—Contusion of the Kidney—Symptoms—Diagnosis—Prognosis—Treatment—Wounds of the Kidney—Nephrectomy 524–549

CHAPTER XV

KIDNEY CALCULI

Symptoms—Diagnosis—Prognosis—Treatment—Nephrolitotomy 550–564

CHAPTER XVI

SUPPURATIVE DISEASES OF THE KIDNEY

Pyelitis—Pyonephrosis—Pyelonephritis—Suppurative Nephritis—Perinephritis—Pyelo-Paranephric Cyst—Renal Infarct 565–588

CHAPTER XVII

HYDRONEPHROSIS—RENAL TUBERCULOSIS—RENAL FISTULA—PARASITES AND TUMORS

PAGE

Hydronephrosis—Congenital Hydronephrosis—Acquired Hydronephrosis—Symptoms—Diagnosis—Prognosis—Treatment.—**Tuberculosis of the Kidney**—Acute Renal Tuberculosis—Chronic Renal Tuberculosis—Symptoms—Diagnosis—Prognosis—Treatment.—**Renal Fistulae.**—**Neoplasms of the Kidney**—Epithelial Tumors—Tumors of Connective-Tissue Origin—Tumors of Heterogeneous Origin.—**Cysts of the Kidney.**—**Parasites of the Kidneys.**—**The Suprarenal Capsules**—Hypernephroma 589–614

CHAPTER XVIII

INJURIES AND DISEASES OF THE SCROTUM AND TESTICLES

Anatomy.—**Diseases of the Scrotum**—Deformities—Injuries of the Scrotum—Wounds of the Scrotum—Œdema of the Scrotum—Emphysema—The Cutaneous Affections of the Scrotum—Gangrene of the Scrotum—Elephantiasis—Tumors of the Scrotum.—**Anomalies of the Testicles**—Anomalies in Number—Anomalies in Size—Anomalies in Migration—Complications of Misplaced Testicles—Treatment—Inversion of the Testicle—Luxation of the Testicle—Torsion of the Testicle.—**Contusions and Wounds of the Testicle**—Contusions—Symptoms—Diagnosis—Prognosis—Treatment—Epididymo-Orchitis from Strain—Wounds of the Testicle.—**Inflammation of the Testicle**—Urethral Epididymitis—Symptoms—Prognosis—Treatment—Epididymo-Orchitis complicating Acute Infectious Diseases—Orchitis complicating Mumps—Typhoid Orchitis—Malarial Orchitis—Orchitis following Tonsillitis—Gouty Orchitis—Orchitis following Smallpox, Scarlatina, or Influenza—Abscess of the Testicle—Gangrene or Necrosis of the Testicle—Fungus or Hernia of the Testicle.—**Tubercular Disease of the Testicle**—Symptoms—Diagnosis—Prognosis—Treatment—Syphilis of the Testicle and Epididymis.—**Tumors of the Testicle**—Carcinoma—Sarcoma—Encysted Hydrocele of the Epididymis and Testis—Cysts of the Testis—Enchondroma—Lymphadenoma—Fibroma—Dermoid Cysts—Myxoma, Osteoma, and Myoma.—**Castration.**—**Hydrocele.**—**Acute Hydrocele.**—**Chronic Hydrocele**—Hydrocele of the Tunica Vaginalis Testis—Symptoms—Diagnosis—Prognosis—Treatment—Injection Treatment—Incision and Drainage—Excision—Choice of Operation—Congenital Hydrocele—Infantile Hydrocele—Inguinal Hydrocele—Fatty Hydrocele.—**Hydrocele of the Cord**—Diffuse Hydrocele of the Cord—Encysted Hydrocele of the Cord—Hydrocele into a Hernial Sac—**Haematocele**—Hæmatocele of the Tunica Vaginalis—Chronic Hæmatocele of the Tunica Vaginalis—Encysted Hæmatocele of the Testis—Intratesticular Hæmatocele—Hæmatocele of the Cord—Loose Bodies in the Tunica Vaginalis.—**Neuralgia of the Testicles**............. 615–703

CHAPTER XIX

INJURIES AND DISEASES OF THE SPERMATIC CORD AND SEMINAL VESICLES

Contusions and Wounds of the Cord—Inflammation of the Cord—Tumors of the Cord—Tuberculosis—Varicocele.—**The Seminal Vesicles**—Anomalies of the Seminal Vesicles—Injuries of the Seminal Vesicles—

PAGE

Vesiculitis or Spermatocystitis—Cystic Swelling of the Seminal Vesicles—Spermatocystic Concretions—Tuberculosis of the Seminal Vesicles—Malignant Growth 704–719

CHAPTER XX

INJURIES AND DISEASES OF THE PROSTATE

Anatomy of the Prostate.—**Contusions and Wounds of the Prostate**—Contusion of the Prostate—Wounds of the Prostate.—**Prostatitis**—Causes—Pathology—Symptoms—Diagnosis—Prognosis—Treatment—Chronic Prostatitis—Irritable Prostate.—**Tuberculosis of the Prostate.**—**Enlargement of the Prostate**—Pathology—Etiology—Symptoms—Diagnosis—Prognosis.—**Treatment of Enlarged Prostate**—Palliative Treatment—Hygienic Treatment—Medicinal Treatment—Intermittent Dilatation—Rectal Injections—Catheterism—Stretching of the Internal Vesical Sphincter.—**Prostatotomy**—Perineal Prostatotomy performed with the Knife—Prostatotomy by the Galvano-Cautery Instrument—Galvano-Cautery Prostatotomy through a Perineal Opening.—**Prostatectomy**—Suprapubic Prostatectomy—Prostatectomy by Median Perineal Incision—Perineal Prostatectomy by Transverse Incision—The Results of Prostatectomy—Castration and Vasectomy—Castration.—**Atrophy of the Prostate.**—**Prostatic Calculi.**—**Malignant Tumors of the Prostate**—Carcinoma—Cysts of the Prostate 720–776

CHAPTER XXI

SEXUAL WEAKNESS AND STERILITY

Mechanism of Erection—Organic Impotence—Psychical Impotence—Atonic Impotence—Genito-Urinary Neuroses—The Diagnosis of Atonic Impotence—Treatment—Prostatorrhœa—Treatment—Involuntary Seminal Emissions—Nocturnal Pollutions—Diurnal Pollutions—Spermatorrhœa—Treatment—Priapism—Impotence in the Female.—**Sterility**—Aspermia — Oligospermia — Oligozoöspermia — Azoöspermia — Treatment 777–804

CHAPTER XXII

PSYCHOPATHIA SEXUALIS

Sexual Hyperæsthesia—Onanism—Treatment of Onanism in Children—Treatment of Onanism in Adolescents and Adults—Satyriasis and Nymphomania—Sexual Anæsthesia—Sexual Paræsthesia—Algolignia—Masochism—Homosexuality—Psychical Hermaphroditism—Urnings—Effemination and Viraginity—Androgyny and Gynandry........ 805–817

CHAPTER XXIII

SYPHILIS

Etiology—Immunity against Syphilis—Syphilitic Reinfection—The Contagion of Syphilis—Methods of Contagion—Types of Syphilis—Periods of Syphilis—The Period of Primary Incubation.—**The Period of Primary Lesion**—Induration—Location of the Chancre.—**The Genital Chancre**—Varieties of the Genital Chancre—Complications of Chancre

PAGE

—Diagnosis of Chancre—The Differential Diagnosis of Genital Chancre —Concealed Genital Chancres—Chancre of the Cervix Uteri—Chancre of the Lip—Chancre of the Tongue—Chancres of the Extremities—Vaccination Chancre—The Prognosis of Chancre—Syphilitic Lymphangitis and Bubo—The Period of Secondary Incubation............. 818–849

CHAPTER XXIV

CONSTITUTIONAL SYPHILIS—THE SYPHILIDES—SYPHILIS OF THE ALIMENTARY CANAL

Syphilitic Fever—Syphilitic Neuralgia—Syphilides—Eruptions on the Mucous Membranes—Syphilitic Alopecia—Classification of Skin Lesions—Erythematous Syphilides—Papular Syphilides—Conical Papular Syphilides—Flat or Lenticular Papular Syphilides—Moist Papules—Papulo-squamous Syphilides—Vesicular Syphilide—Pustular Syphilide—Pigmentary Syphilide—Tubercular Syphilide—The Bullous Syphilide—The Gummatous Syphilide.—**Syphilitic Affections of the Appendages of the Skin**—Syphilitic Alopecia and Onychia.—**Syphilitic Lesions of the Mucous Membrane**—Erythematous Syphilide—Papular Syphilide —Papulo-squamous Syphilide—Gummata—Syphilis of the Tongue—Syphilis of the Gums—Syphilis of the Palate—Syphilis of the Pharynx —The Œsophagus, Stomach, and Intestines—The Rectum and Anus.. 850–903

CHAPTER XXV

SYPHILIS OF THE NERVOUS SYSTEM—OF THE EYE—OF THE EAR—OF THE RESPIRATORY TRACT

Cerebral Syphilis — Etiology — Pathology — Symptomatology — Syphilitic Neuralgias—Headache from Bone-Lesions—Headaches due to Syphilitic Affections of the Brain or its Envelopes—Prodromal Cephalalgia of Tertiary Lesions—Parasyphilitic Cephalalgia—Diagnosis of Intracranial Syphilis.—**Syphilis of the Spinal Cord**—Syphilitic Meningitis — Acute or Subacute Myelosyphiloses — Chronic Myelosyphiloses — **Tabes Dorsalis.—Syphilis of the Nerves.—Syphilis of the Eye**—Syphilis of the Lachrymal Apparatus—Syphilitic Affections of the Cornea —Syphilis of the Sclera—Syphilis of the Iris—Syphilis of the Ciliary Body—Syphilis of the Choroid, Retina, and Optic Nerve—Atrophy of the Optic Nerve—Syphilitic Palsies of the External Ocular Muscles.—**Syphilis of the Ear.—Syphilis of the Respiratory Tract**—Syphilis of the Nose—Syphilis of the Nasal Cavities—Acute Syphilitic Rhinitis—Hypertrophic Rhinitis—Atrophic Rhinitis—Gummata—Syphilis of the Larynx—Syphilis of the Lungs 904–937

CHAPTER XXVI

SYPHILIS OF THE BONES AND JOINTS—OF THE MUSCLES—OF THE HEART AND BLOOD-VESSELS—OF THE LYMPHATIC SYSTEM—OF THE LIVER—OF THE SPLEEN—OF THE PANCREAS—OF THE GENITO-URINARY ORGANS

Osteoperiostitis—Rarefying Ostitis—Gummatous Periostitis, Ostitis, and Osteomyelitis—Osteosyphilosis of the Cranium—The Vertebræ—The

PAGE

Tibia—The Phalanges.—**Syphilis of the Joints**—Arthralgia—Synovitis—Gummatous Arthritis—Bursitis—Syphilis of the Muscles—Acute Irritative Myositis—Chronic Interstitial Myositis—Gummatous Myositis—Syphilitic Tenosynovitis.—**Syphilis of the Circulatory System**—Heart—Arteries—Veins.—**Syphilis of the Lymphatic System.**—**Syphilis of the Liver**—Precocious Syphilis of the Liver—Tertiary Syphilis of the Liver.—**Syphilis of the Spleen.**—**Syphilis of the Pancreas.** — **Syphilis of the Uro-Genital System** — The Kidneys — The Ureters and the Bladder—The Epididymitis and Testicles—Syphilitic Epididymitis—Syphilitic Orchitis—Syphilis of the Vasa Deferentia, Seminal Vesicles, Prostate, Urethra, and Erectiles Bodies of the Penis.—**Syphilis of the Ovaries, Uterus, Vagina, and Vulva.**—**Syphilis of the Mammary Gland.**—**The Prognosis of Syphilis**................ 938–968

CHAPTER XXVII

SYPHILITIC HEREDITY—HEREDITARY SYPHILIS

Descent from the Father—Descent from the Mother—Mixed Heredity—Direct Infection—The Period of Syphilitic Heredity—Conceptional Syphilis—Syphilis and Marriage—Prognosis of Syphilitic Heredity.—**Hereditary Syphilis.** — **Skin and Mucous Membrane Lesions of Hereditary Syphilis**—Erythematous Syphilides—Papular Syphilides and Mucous Patches—Vesicular Syphilide—Pustular Syphilide—Bullous Syphilide—Tubercular and Gummatous Syphilides—The Lesions of the Mucous Membrane.—**Hereditary Syphilis affecting the Eye.**—**Hereditary Syphilis affecting the Ear.**—**Hereditary Syphilis affecting the Teeth.**—**Hereditary Syphilis affecting the Bones and Joints**—The Bones—Syphilitic Dactylitis—The Joints.—**Hereditary Syphilis affecting the Lymphatic Glands.**—**Hereditary Syphilis affecting the Nerve-Centres and Nerves**—The Brain—The Spinal Cord,—**Hereditary Syphilis affecting the Viscera**—The Lungs—The Liver—The Spleen—The Pancreas—The Intestines—The Kidneys.—**Hereditary Syphilis affecting the Testicles.**—**Diagnosis of Inherited Syphilis**—Early Hereditary Syphilis—Late Hereditary Syphilis............ 969–1000

CHAPTER XXVIII

THE TREATMENT OF SYPHILIS

Prophylactic Treatment.—**The Abortive Treatment**—Excision or Destruction of the Chancre—Constitutional Abortive Treatment.—**The Constitutional Treatment of Syphilis**—Modified Expectant Treatment—Interrupted Treatment of Syphilis—Continuous Treatment.—**Systematic Treatment of Syphilis**—The Systematic Treatment by Iodides—The Toxic Effects of Mercury—The Toxic Effects of Iodides.—**Methods of giving Mercury**—Mouth Administration—Inunctions—Hypodermic Injections—Vaporization—Mercuric Baths, Thermal Springs, and Heat—Electric Baths—Intravenous Injection of Mercury—The Elimination of Mercury—The Use of Iodides in Syphilis—Serum Treatment—Zittmann's Treatment of Intractable Syphilis.—**Local Treatment of Syphilis.**—**The Treatment of Hereditary Syphilis**.............. 1001–1056

LIST OF ILLUSTRATIONS.

PLATES.

FIGURE PAGE
1. Double penis 5
8. Operation for phimosis 15
9. Operation for phimosis 15
10. Operation for phimosis 16
11. Operation for phimosis 16
16. Balanitis 31
17. Herpes of the glans 31
18. Multiple chancroids of the coronary sulcus 38
19. Chancroid of labium major 38
20. Exulcerating or superficial chancroid 39
21. Follicular chancroid 39
23. Multiple chancroids. (Fox.) *Colored* 42
24. Phagedenic chancroid 42
25. Chancroidal bubo 42
30. Epithelioma, ulcerating form 64
31. Epithelioma, vegetating form 64
54. Acute gonorrhœa. *Colored* 114
55. Acute pyogenic urethritis. *Colored* 114
56. Chronic gonorrhœa. *Colored* 114
57. Urinary shred. *Colored* 114
66. Gonorrhœal conjunctivitis. Swelling of the lids and free discharge.... 194
67. Gonorrhœal conjunctivitis. Infiltration of bulbar and palpebral conjunctiva 194
103. Hypertrophy of the lateral lobes of the prostate. (Watson.) 304
114. *A*. Bacteriuria. *B*. Pyuria. *C*. Tubercle bacilli in urine. *Colored*.... 352
115. Sediments of acid and alkaline urine. *Colored*........ 358
122. Male and female ureter-cystoscopes 370
123. 1. Aluminum swab or applicator. 2. Urethral tablet depositor and obturators. 3. Aspirator. 4. Inflating bulbs with metal extremity for receiving warm air. 5. Syringe. 6. Funnel with tubing for irrigating kidney pelves 370
124. *A*. Median obstruction in prostatic hypertrophy. (Nitze.) *B*. Showing a widespread malignant tumor from the prostate. (Nitze.) *C*. Villous tumor attached to the bladder-wall. (Nitze.) *D*. Shows the stump of a villous tumor which has sloughed off. (Nitze.) *E*. An air-bubble which was carried into the bladder by a catheter. (Nitze.) 378
125. *A*. A cystoscopic picture of the normal bladder. (Nitze.) *B*. Ramifying vessels on the bladder-wall. (Nitze.) *C*. The ureteral orifice on a well-developed ureteral eminence. (Nitze.) *D*. The ureteral papilla is wanting. (Nitze.) *E*. The ureteral papilla immediately before evacuation of the urine. (Nitze.) *F*. Well-developed ureteral papilla. (Nitze.) 379

FIGURE PAGE
126. Pictures of the bladder-wall and internal urethral orifice in cases of prostatic hypertrophy. (Nitze.) 378
127. Right and left ureteral orifices. (Casper.) *Colored* 378
135. Large vesical calculus. (Pancoast.) 444
142. Opening and closing the blades of the instrument while searching for and grasping the calculus 454
143. Crushing a small, soft calculus 454
144. Crushing a large, hard stone 454
145. Evacuating fragments after the calculus has been crushed 454
150. *A*. Normal relations. *B*. Bladder distended. *C*. Bladder and rectum distended 474
151. Vesical calculus almost completely filling an hypertrophied bladder 475
159. Myxosarcoma. (Albarran.) 484
160. Lobulated papilloma (epithelial cancer). (Albarran.) 488
161. Carcinoma (epithelial cancer). (Albarran.) 488
169. Multiple calculi in the ureter. (Pancoast.) 516
170. Position and relation of the kidneys and other retroperitoneal structures. *Colored* 524
172. Normal kidney. (Brödel.) 526
175. Various forms of kidney-stone, illustrating the irregularities in shape. (Torres.) 550
176. Various kinds of urinary calculi. *Colored* 550
179. Roentgen ray shadowgraph showing calculus in the pelves of the left kidney. The renal artery and the colon are also shown 556
180. Calculus impacted in first portion of ureter. (Pancoast.) 557
192. Showing the relations and coverings of the testicle and epididymis. (Testut.) *Colored* 616
227. Obstruction by the median portion of the prostate 734
228. Separate tumors springing from the lateral lobes of the prostate. (Watson.) 734
229. Bilateral hypertrophy of the prostate. (Watson.) 734
230. Hypertrophy of the median lobe of the prostate. (Watson.) 735
231. Hypertrophy of the median and one lateral lobe of the prostate. (Watson.) 735
232. Bladder and prostate cut through longitudinally in the median line 735
240. Exposure of membranous urethra after division of recto-urethritis. (Young.) 762
241. Opening of urethra on sound, preparatory to introduction of tractor. (Young.) 762
242. Tractor in position, blades separated, prostate pulled down, posterior surface exposed. (Young.) 762
243. External enucleation begun. (Young.) 763
244. Delivery of a small median portion into lateral cavity by use of finger instead of tractor. (Young.) 763
245. Delivery of median portion into lateral cavity. (Young.) 763
255. Chancre of the reflected layer 826
256. Chancre of the meatus 826
258. Chancre of the corona. (Fox.) *Colored* 828
261. Chancre of the tongue. (Fox.) 842
264. Erythematous syphilide. (Fox.) 860
265. Flat papular syphilide 862

FIGURE PAGE
266. Acuminated papular syphilide. (Fox.) 862
267. Acuminated papular syphilide. (Fox.) 862
268. Large flat papular syphilide. (Fox.) 863
269. Large flat papular syphilide. (Fox.) 863
270. Large flat papular syphilide 863
271. Vegetation and mucous patches about the vulva 863
272. Large flat papular syphilide, showing scaling 863
277. Papulo-squamous syphilide. (Fox.) 866
281. Papulo-squamous syphilide of the hand. (Fox.) *Colored* 868
282. Papulo-squamous syphilide of the palm. (Fox.) *Colored* 868
283. Papulo-squamous syphilide of the palm. (Fox.) *Colored* 868
284. Large pustular syphilide. (Fox.) 872
285. Pustulo-crustaceous syphilide. (Fox.) *Colored* 872
288. Pustular syphilide (pustulo-crustaceous). (Fox.) 874
289. Pustular syphilide (pustulo-crustaceous). (Fox.) 874
290. Flat pustular and papulo-squamous syphilide 875
294. Tubercular syphilide. (Fox.) *Colored* 878
297. Ulcerating tubercular syphilide. (Fox.) *Colored* 878
298. Squamous circinate syphilide. (Fox.) *Colored* 878
299. Tubercular syphilide. (Fox.) 880
300. Tubercular syphilide. (Fox.) 880
301. Syphilitic rupia following the bullous syphilide 880

FIGURES.

2. Application of forceps in circumcision 11
3. Appearance after first cut in circumcision 11
4. Trimming of mucous membrane flaps in circumcision 11
5. Appearance after flaps have been trimmed in circumcision 11
6. Insertion of first and second sutures in circumcision 12
7. Operation of circumcision completed 12
12. Paraphimosis 19
13. Reduction of paraphimosis 20
14. Reduction of paraphimosis 21
15. Osseous growth of the penis. (Demarquay.) 28
22. Indurated elevated chancroid 41
26. Chancroidal phimosis 45
27. Chancroidal ulceration of an incision for relief of phimosis 54
28. Venereal warts on the penis 61
29. Epithelioma of the penis 64
32. Epithelioma of the penis with glandular involvement 65
33. Cross-section of the penis showing infiltration of epithelioma 65
34. Forms of penile hypospadia 74
35. Peno-scrotal hypospadia 75
36. Penis straightened after transverse cut of lower surface 78
37. Transverse wound sutured longitudinally: glandular urethra formed... 78
38. Freshened areas, incisions, and sutures in forming glandular urethra... 78

FIGURE PAGE
39. Formation of penile urethra 79
40. Formation of penile urethra completed 79
41. Glandular epispadia. (Kaufmann.) 81
42. Usual form of epispadia 82
43. Formation of glandular urethra. (Thiersch.) 84
44. Outlining of flaps to form penile urethra 85
45. Flaps for forming penile urethra folded over and held in position by sutures 85
46. 1. Transverse defect between penile and glandular urethras; 2, 3, oblique incision through foreskin. (Thiersch.) 87
47. Foreskin brought up behind the glans and sutures uniting freshened edges of foreskin 87
48. Closing posterior defect in epispadia 87
49. Suture of second flap 87
50. Cured epispadia. (Thiersch.) 88
51. Urethral forceps 98
52. Urethral calculi showing segmentation 99
53. Urethral calculi showing mushroom shape. Cross-sections 100
58. Urethral syringe 134
59. Irrigating bag 138
60. Subacute gonorrhœa; pus; epithelium; mixed infection. (Guyon.) 146
61. Instillator for the posterior urethra 159
62. Tommasoli's ointment-carrier 162
63. Prostatic dilator 163
64. Short straight bougie 172
65. Gonorrhœal phimosis 185
68. Gonorrhœal conjunctivitis passing into a panophthalmitis 195
69. Linear strictures of the urethra. (Voillemier.) 207
70. Annular stricture of the urethra 208
71. Tortuous stricture of the urethra 208
72. Traumatic stricture of the urethra. (Voillemier.) 212
73. Cast of the urethra. (Tetzel.) 219
74. Bougie à boule 220
75. Gauge for urethral instruments 220
76. Filiform bougies 228
77. Tunnelled catheter. Enlargement of tip showing position of tunnel 229
78. Steel sound 229
79. Tip of catheter just entering the fixed curve of the urethra. (Antal) 231
80. Fixed urethral curve 232
81. Fixed curve of the urethra obliterated by the passage of a straight instrument. (Antal.) 232
82. Passing a sound 233
83. Passing the sound 234
84. Passing the sound 234
85. Passing the sound 235
86. Position of sound after passing showing tip has entered bladder 235
87. Maisonneuve's urethrotome 244
88. Teevan's urethrotome 244
89. Gerster's urethrotome 246
90. Teale's probe-ended gorget 247
91. Syme's grooved staff 248

FIGURE PAGE
92. Tunnelled catheter staff 248
93. Wheelhouse's staff 251
94. Closure of fistula 268
95. Papilloma of the urethra 270
96. Valentine's endoscope 274
97. Chetwood's urethroscope 275
98. Swinburne urethroscope 275
99. Sterilizing-box for soft urethral instruments 282
100. Tumor formed by the distended bladder 296
101. Hypertrophied bladder from urethral stricture 299
102. Hypertrophy of the lateral and median lobes of the prostate. (Watson.) 305
104. Soft rubber catheter 307
105. Olivary catheter 308
106. Conical catheter 308
107. Elbowed catheter 308
108. Double-elbowed catheter 308
109. Cylindrical catheter 308
110. Silver probe catheter 308
111. Soft rubber self-retaining catheters 312
112. Securing the catheter for continuous catheterization 313
113. Securing the catheter for continuous catheterization 314
116. Aëro-cystoscope 367
117. Cystoscope with the light and window on the outer aspect of the beak... 368
118. Catheterizing cystoscope 369
119. Cabot's catheterizing cystoscope 369
120. Elsner's catheterizing cystoscope 370
121. Pryor's cystoscope for the female 370
128. Cathelin's urine separator 380
129. Cathelin's urine separator 381
130. Side view of pelvic viscera 388
131. Vesical triangle. (Sappey.) 390
132. *A*. Day urinal. *B*. Night and day urinal 394
133. Concentric hypertrophy of the bladder 398
134. Atony of the bladder, with dilatation 400
136. Stone-searcher 446
137. Thompson's stone-searcher 446
138. Bigelow's lithotrite 452
139. Weiss's lithotrite 452
140. Jaws of Bigelow's lithotrite 453
141. Bigelow's evacuator and tubes 454
146. Lithotomy 465
147. Grooved lithotomy staff 465
148. Stone forceps (curved) 466
149. Calculus scoop 466
152. Uric acid calculus. Exact size. Weight, nine and one-half ounces. Removed by suprapubic section 476
153. Another view of same 476
154. Cushing's suture for closing the bladder 477
155. Gibson's method of closing the bladder 478
156. Gibson's method of closing the bladder 479

FIGURE PAGE
157. Dawbarn's method of suprapubic bladder-drainage 480
158. Hook for extraction of hairpins from the female bladder 485
162. Thompson's forceps for removing vesical tumors 493
163. Implantation of the ureter into the bowel 499
164. The musculature of the trigone. (Young.) 505
165. End-to-end anastomosis 509
166. End-in-side anastomosis; first stage 509
167. End-in-side anastomosis; second stage 510
168. End-in-side anastomosis, with reinforcing sutures 510
171. Renal pelvis dissected from the pyramids. (Henle.) 526
173. Proper method of applying corset for movable kidney 534
174. Sustaining sutures for fixing the kidney. (Brödel.) 536
177. Multiple bilateral renal cysts and calculi 551
178. Renal calculus. (Actual size.) (American Text-Book of Surgery) 552
181. Lines of incision for operating on the kidney by the lumbar route 561
182. Lateral view of kidney showing line of incision. (Brödel.) 562
183. The proper position for incision of the kidney. (Brödel.) 563
184. Method of suturing split kidney. (Brödel.) 563
185. Complete destruction of kidney by an abscess 578
186. Destruction of the kidney by hydronephrosis 592
187. Large vesical calculus. Contracted hypertrophied bladder, double hydronephrosis 592
188. Cyst of the kidney 610
189. Large cyst of the kidney 610
190. Anatomy of the left testis. (Sappey.) 616
191. Anatomy of the left testis. (Sappey.) 616
193. The lobules of the testis, the rete vasculosum, etc. 618
194. The efferent canal and epididymis. (Sappey.) 618
195. Dissection showing seminal vesicles and ampullæ of the vasa in relation to the bladder and prostate 619
196. Elephantiasis of the penis and scrotum, showing the result of operation 625
197. Diagram showing the size and relative position of the testicle and epididymis in acute epididymitis. (Kaufmann.) 646
198. Epididymitis suspensory bandage 649
199. Tubercular epididymitis. (Monod and Terrillon.) 660
200. Cancer of the right testicle. (Monod and Terrillon.) 667
201. Intravaginal spermatocele. (Hochenegg.) 670
202. Encysted hydrocele 671
203. Multilocular cyst of the epididymis. (Monod and Terrillon.) 671
204. Lymphadenoma of the testicle 674
205. Vertical section of hydrocele. (Kocher.) 681
206. Hydrocele 682
207. Vertical section of a hydrocele. (Kocher.) 684
208. Inguinal hernia with hydrocele. (Kocher.) 685
209. Inguinal hernia invaginating the upper portion of the sac of a hydrocele. (Kocher.) 686
210. Tapping a hydrocele 686
211. Bilocular hydrocele. (Beraud.) (Kocher.) 691
212. Congenital hydrocele with hernia 692
213. Inguinal hernia, with hydrocele of the cord 696

FIGURE PAGE
214. Lipoma of the cord. (Péan.) 705
215. Varicocele. (Osborn.) (Monod and Terrillon.) 706
216. Dilatation of veins in hydrocele. (Kocher.) 707
217. Right seminal vesicle. (Testut.) 710
218. Long section of dilated seminal vesicle. (Sappey.) 710
219. Deferent canal and seminal vesicle. (Testut.) 711
220. Horizontal section of the bladder and seminal vesicles. (Testut.) 711
221. Relations at the posterior surface of the bladder. (Testut.) 712
222. Posterior urethra exposed by splitting its upper wall. (Testut.) 712
223. Vertical section of pelvis. (Testut.) 720
224. Plexus of vessels surrounding the prostate. (Testut.) 721
225. Ejaculatory ducts, seminal vesicles, etc. (Murphy.) 722
226. Rectal irrigator 728
233. Distorted urethra with enlarged prostate. (Murphy.) 737
234. Prostatic obstruction. Effect on bladder and kidneys 738
235. Prostatic obstruction with hypertrophy of the bladder-wall and contraction of its cavity 738
236. Young's galvano-cautery prostatic incisor 755
237. Chetwood's galvano-cautery prostatic incisor 757
238. Various perineal incisions 761
239. Prostatectomy through retracted edges of median incision. (Ferguson.) 762
246. Young's prostatic tractor 763
247. Young's lobe forceps 763
248. Murphy's hooks for prostatectomy 764
249. Enucleation of lobes of prostate. (Young.) 765
250. Suburethral method of enucleating median bar. (Young.) 765
251. Division of lateral wall of urethra for removal of large calculus. (Young.) 766
252. Perineal drainage after prostatectomy. (Ferguson.) 767
253. Psychrophore 790
254. Anastomosis between the vas deferens and the head of the epididymis .. 803
257. Chancre of the coronary sulcus 827
259. Chancre of the lip 839
260. Chancre of the lip 840
262. Chancre of the tongue 842
263. Chancre of the hand 844
273. Mucous patches of the lips 863
274. Mucous patches about the anus 863
275. Papular syphilide, showing papillary overgrowth 864
276. Syphilitic vegetations 865
278. Papulo-squamous syphilide 867
279. Papulo-squamous syphilide. (Fox.) 867
280. Papulo-squamous syphilide of the hand. (Fox.) 868
286. Pustular syphilide. (Fox.) 873
287. Pustular syphilide. (Fox.) 874
291. Large, flat pustular syphilide. (Fox.) 875
292. Serpiginous syphilide. (Fox.) 876
293. Non-ulcerating tubercular syphilide. (Fox.) 878
295. Non-ulcerating tubercular syphilide. (Fox.) 878
296. Tubercular (squamous) syphilide. (Fox.) 879
302. Gummatous syphilide. (Fox.) 882

FIGURE PAGE
303. Single ulcerating gumma 883
304. Ulcerating gummata becoming confluent. (Fox.) 883
305. Multiple gummata of the leg. (Fox.) 884
306. Sloughing gumma of the leg 885
307. Ulcerating gummata of the malleolar region. (Fox.) 886
308. Syphilitic alopecia following ulcerative lesions. (Fox.) 888
309. Gummatous ulceration destroying the nose. (Fox.) 932
310. Skull showing the results of gummatous osteoperiostitis 940
311. Vault of the cranium exhibiting the results of gummatous osteoperiostitis 941
312. Tubercular and gummatous ulceration of hereditary syphilis 979
313. Syphilitic dactylitis 992
314. Hereditary syphilis. (De Schweinitz.) 999

BOSTON MEDICAL LIBRARY
FEB 27 1907

GENITO-URINARY DISEASES
AND
SYPHILIS.

- 7 29

CHAPTER I.

DISEASES AND INJURIES OF THE PENIS.

Anatomy of the Penis.—The penis in size bears less constant relation to general physical development than does any other organ of the body. Its average length is about three inches when in the flaccid condition and twice that when erect; its circumference when it is flaccid averages about three inches. It is made up in the main of erectile tissue. This is separated into three distinct compartments by investments of tough fibrous tissue. The bulk of the penis is formed by the two corpora cavernosa lying side by side and capped by the glans, which is a continuation of the corpus spongiosum. The corpus spongiosum, much smaller in circumference than either of the cavernous bodies, lies in the angle formed by their apposition, bearing to them the relation that a ramrod does to the double barrel of a gun.

The cavernous bodies arise from the tuberosity and ascending ramus of the ischium on each side, and pass upward, forward, and inward until they become closely apposed to each other beneath the pubic symphysis. They are then continued forward, each in a fibro-elastic sheath, which in front does not form a complete partition between the two. They terminate in blunt extremities, which are capped by the glans.

The spongy body—composed of erectile tissue and also invested by a fibro-elastic sheath—is made up of a central portion of comparatively small diameter, through which the urethra passes, and of two terminal expansions, the glans penis, capping the cavernous bodies, and the bulb, lying in the angle formed by the two convergent crura of the cavernous bodies, and attached to the lower surface of the triangular ligament. The flange-like expansion at the base of the glans is termed the corona, and the depression behind this is called the cervix, or coronary sulcus.

In addition to the tough fibro-elastic sheath with which the spongy and cavernous bodies are each supplied, there is a sheath, termed Bück's fascia, or the fascia of the penis, which binds these structures together. This covers in the two rounded extremities of the corpora cavernosa and is firmly attached to the base of the glans penis. Passing backward as a complete investment of the body of the penis, it is continuous with the suspensory ligament above and with the deep layer of the superficial fascia below. Superficial to this fascia lies an extremely loose layer of areolar tissue without fat, containing a thin layer of muscular fibres.

The thin movable skin covering the penis is usually continued forward till it partly or completely covers the glans; it is then doubled back upon itself, is attached to the cervix, and is continued forward over the glans penis till it joins the mucous membrane of the urinary meatus. This reduplication is termed the prepuce, or foreskin. It passes forward as a tough fibrous band, called the frænum, from the lower central part of the coronary sulcus to just beneath the urinary meatus. At the preputial orifice the subcutaneous layer is especially well developed, often forming a tough fibrous ring. The inner surface of the prepuce and the covering of the glans penis are moist, thin, and more like mucous membrane than like ordinary skin. On the flange-like expansion of the glans, particularly on its anterior aspect, are placed the glands of Tyson, which secrete a cheesy substance, termed smegma; this, when it undergoes decomposition, has a characteristic offensive odor.

The suspensory ligament of the penis is a strong, triangular, fibro-elastic band attached to the front of the pubic symphysis and to the two cavernous bodies at their angle of junction.

The muscles of the penis are the erector penis or ischio-cavernosus, the accelerator urinæ or bulbo-cavernosus, and the unstriped muscular fibres of the erectile tissues and of the urethra.

The erector penis muscles are more concerned in exercising pressure upon veins, and thus increasing turgescence, than in mechanically altering the position of the penis. They arise from the ischiatic tuberosities and are inserted in the lower side of the fibrous sheath of the corpora cavernosa.

The bulbo-cavernosi arise from the central perineal point, and, passing upward and forward, encircle the bulb and posterior part of the spongy body. The action of these muscles is to expel by their contraction the last drops of urine and to drive forward with force the semen when it passes from the posterior urethra.

The dorsal arteries of the penis, two in number, run forward through the suspensory ligament on each side of the dorsal vein to the glans and prepuce, also giving branches to the cavernous bodies. The arteries of the corpora cavernosa give the main blood-supply to the erectile tissue of the cavernous bodies. The artery of the bulb gives the main blood-supply to the corpus spongiosum. All these vessels are derived from the internal pudic. In addition, there is a collateral supply due to an anastomosis of the same vessels with branches of the external pudic.

The dorsal vein of the penis is the largest efferent vessel of this organ; it passes backward in a groove on the dorsum of the penis through the suspensory ligament and into the prostatic plexus; the smaller veins nearly all pass backward, pouring their blood into the same plexus.

The nerves of the penis are derived from the internal pudic (the dorsal nerve of the penis) and from the hypogastric plexus (nervi erigentes to the erectile tissue).

The lymphatics pass partly to the inguinal region, particularly those of the glans, the foreskin, the surface of the penis, and the anterior part of the urethra, partly to the deep pelvic lymphatic system.

The tensile strength of the penis, because of its tough fibrous investments, is sufficient to bear the entire weight of the body. The fibrous investment of the blunt extremities of the two cavernous bodies where they are capped by the glans delays, and sometimes prevents, the backward extension of inflammatory or infiltrating processes, particularly cancerous infiltration, which primarily involve the glans. This fibrous sheath, being a continuation of the deep layer of the superficial fascia, also limits the forward extension of urinary and purulent infiltrations beneath this fascia, such infiltrations sparing the glans.

The free blood-supply to the penis and the rich innervation of the organ insure rapid healing in case of wounds, and justify conservative treatment even though it has been nearly severed or extensively crushed.

The lymphatic vessels, passing as they do to the inguinal glands and to the glands of the pelvis, carry infection in both directions: hence, for instance, in case of malignant disease with involvement of the glands of the groin, removal of the disease together with the enlarged inguinal glands gives no assurance against deep recurrence of the growth.

The lax vascular subcutaneous tissue readily becomes œdematous either from local or from general causes, especially in the region of the foreskin.

The delicate richly innervated skin is extremely sensitive to irritants.

Anomalies of the Penis are rarely observed unassociated with other malformations. A large percentage of those thus afflicted are mentally deficient. The penis may be absent, concealed, minute, gigantic, double, twisted, or adherent.

ABSENCE OF THE PENIS.—Harris has collected eight cases of this anomaly, unassociated with other deformities, the testes being normal. In one case the urethra opened into the perineum, in the others just within the anal sphincter. Demarquay quotes the case of a patient who had reached the age of twenty-seven when he sought medical advice for the relief of an acute orchitis. The urethra opened into the anus, and there was in the perineum, just anterior to the anus, a small wart-like projection of erectile tissue. Venereal excitement caused this tissue to become turgid, and, if sufficiently prolonged, was followed by escape of semen through the urethra.

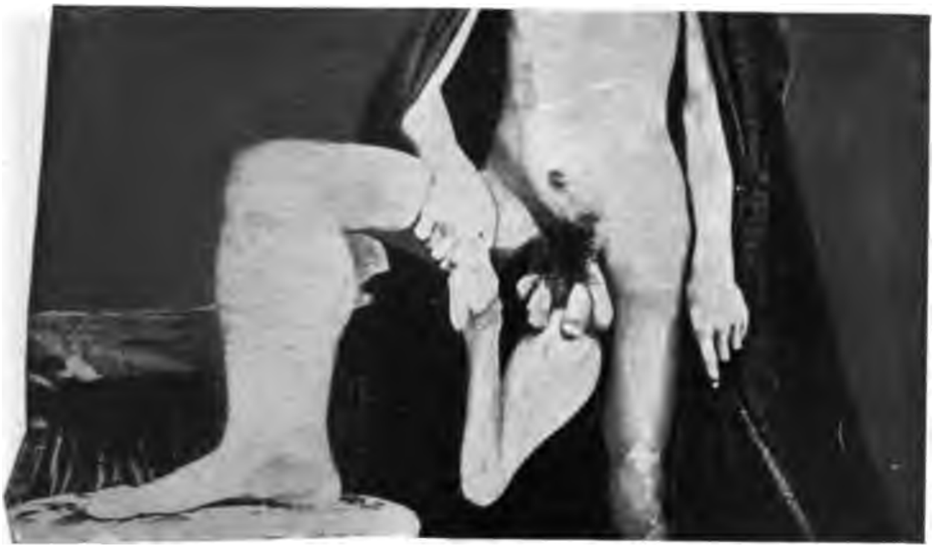
CONCEALED PENIS.—Absence of the penis may be seeming only, the organ being concealed beneath the surface. In one such case an incision freed the organ and enabled the infant, who was suffering from retention of urine, to pass his water.

Treatment of the malformation is usually unnecessary, since concomitant deformities will first require care. When, however, there is a chance for survival, opportunity should be taken to search thoroughly for a concealed rudimentary penis. This, if found, should be dissected free, and, by plastic operation, covered with integument derived from the surrounding parts.

MICROPENIS.—Arrested growth of an otherwise perfectly formed penis is by no means uncommon, though this rarely produces results so marked that the condition may be properly termed anomalous. In general terms it may be stated that a flaccid adult penis less than two inches in circumference and two and a half inches in length is abnormal, though even in such a case the erectile tissue may be dilatable to an unusual degree, thus making the organ normal in size when in a condition of physiological activity. In some reported cases the penis has varied in size from that of a quill to that of the last two joints of the little finger.

As seen in adults, stunting of the penis is perhaps more commonly due to excessive masturbation or to other causes interfering with development than to congenital defect.

FIG. 1.



Double penis.

Treatment.—A minute penis when observed at birth or shortly after does not require treatment, except for the relief of preputial adhesions or of tight phimosis, since the organ, as is the case with the testicles, may before puberty, or about this time, grow rapidly and attain normal dimensions. A tight foreskin should be removed, and any abnormal condition interfering with local growth should be remedied.

When the condition is observed soon after puberty or in the young adult the prospect for ultimate growth is by no means hopeless. In these cases physiological activity of the part is at times followed by a rapid growth till normal size is reached.

For the purpose of developing a stunted penis a suction apparatus has been employed. The penis is slipped into a large cylinder fitting closely around the root of the organ; from this cylinder the air is partly exhausted by means of a rubber bulb. This causes congestion, distention of the erectile tissue, and, it is asserted, permanent enlargement. Such a treatment to be efficient would have to be long continued.

MEGALOPENIS.—As has already been observed, the size of the organ bears no constant relation to the size or strength of the individual. In congenital imbeciles it is often of unusual size, and in dwarfs and hunchbacks it is not uncommonly developed not only out of proportion to the other parts of the organism, but even beyond the average for individuals of normal growth. Hypertrophy of the penis is at times an inconvenience, and may even be a source of danger, since an excessive development predisposes to abrasions and fissures through which inoculation with venereal diseases may occur.

There is no surgical treatment for this affection, though by mechanical appliances the interference with function may be partly or completely obviated.

DOUBLE PENIS.—A few authentic cases illustrative of this anomaly have been reported. The two organs are usually placed side by side, and there are other evidences of monstrosity by fusion. In at least two reported cases each organ was functionally perfect. (Fig. 1.)

Surgical treatment is not indicated.

TORSION OF THE PENIS, or a twisting of the penis on its long axis so that the frænum looks forward, is extremely rare, unless hypospadia or other malformation is present. Urination and ejaculation of the semen are not materially interfered with: hence treatment would be indicated only from a cosmetic stand-point.

ADHERENT PENIS.—Rarely, as an isolated anomaly, the penis is found adherent to the scrotum through nearly its whole extent. This materially interferes with function, and, when the penis is of normal size and not incurved, should be operated on as soon as it is discovered.

The *treatment* consists in cutting through the skin attachment of the penis till the organ is entirely freed, providing for the closure of the raw surface by a plastic operation where necessary.

Anomalies of the Prepuce.—The foreskin may be absent, incompletely developed, redundant, or adherent to the glans; the preputial orifice may be absent or extremely small; the frænum may be abnormally short.

Absence or incomplete development requires no treatment, nor does redundancy urgently demand surgical intervention, except where it is complicated with phimosis and an irritated or inflammatory condition of the glans.

Adhesions between the glans and the inner surface of the prepuce are present in the majority of infants. At times such adhesions are the result of a balanoposthitis; they are usually congenital, and are generally associated with phimosis.

Adhesions may appear in the form of comparatively narrow bridles or bands, or may involve broad areas. Commonly the symphysis is limited to the corona, and is so tight that in the operation for circumcision the line of adhesion is frequently taken for the normal line along which the mucous membrane is reflected behind the glans, and thus the coronary sulcus is not freed of the retained smegma usually found here in such cases. Exceptionally the whole surface of the glans adheres to the foreskin, the lips of the meatus alone being free. Adhesions between the foreskin and the glans sometimes act as a source of reflex irritation, causing nervous phenomena of a convulsive or paralytic type. This is, however, very exceptional, and probably never occurs except when there are distinct local signs of irritation. Children in whom the adhesions are tightest and most extensive commonly exhibit a penis much below the average size. In the adult such adhesions, at least as congenital deformities, are rare, since the bond of union is easily torn by slight mechanical interference. Occasionally the bands are so tough that nothing short of an operation can strip them.

The *treatment* of adhesions between the glans and the foreskin is in ordinary cases readily carried out. Phimosis having been relieved, either by stretching the preputial orifice or by circumcision, the adhesions between the two mucous surfaces of the foreskin and the glans can be stripped back by firm sponging, or by the pressure of the thumb-nail, or by blunt dissection, using the flat end of a probe for this purpose. Sometimes rough handling is necessary before the adhesions yield. The stripping back should be continued till the coronary sulcus is freed through its whole extent, usually exposing a ring of smegma. The raw surfaces resulting from this stripping should be well coated with boric ointment (acid. boric., ʒi; ung. petrol. carbolat., ℥i), when the prepuce can be drawn forward again if circumcision has not been performed. Twice daily the raw surfaces should be exposed, washed with a mild antiseptic, and protected by boric ointment. In a week or ten days healing will be complete. This stripping operation should be conducted with ordinary antiseptic precautions, since death from cellulitis has more than once resulted when such precautions were neglected. Firm fibrous adhesions require the use of the knife.

Obliteration or occlusion of the preputial orifice may not be detected directly after birth, but cannot long escape attention, since failure to pass water and the formation of a tumor at the end of the penis, due to distention of the preputial sac with urine, are certain to be noticed. Demarquay, however, reports a case of four months' standing with a prepuce distended to the size of a bladder.

The *treatment* is circumcision.

Narrowing of the Preputial Orifice—Phimosis.—The term phimosis implies that the preputial orifice is so narrowed that the foreskin cannot be retracted behind the glans. The orifice may be so small that a probe will pass with difficulty. Phimosis may be temporary or permanent. In the former case it is due to inflammatory swelling or infiltration; in the latter, to congenital formation, or new growth, or cicatricial contraction.

Congenital Phimosis.—This condition is present in the great majority of male infants at birth, and persists up to the fifth or seventh year, at which time there usually takes place distinct enlargement of the preputial orifice, so that the foreskin can be stripped back without much difficulty.

Phimosis when moderate in degree and not giving rise to obstruction or inflammation occasions no symptoms. Its complications are, however, distressing, and sometimes cause permanent impairment of health.

The complications of phimosis are:

1. Those due to local irritation: *i.e.*, balanitis, balanoposthitis, adhesions, venereal warts, fissures.

2. Those due to obstruction: subpreputial calculi, retained secretion, irritability of the bladder, hemorrhoids, hernia, and dilatation of the bladder, of the ureters, and of the kidney pelves.

3. Those due to reflex action: retention or incontinence of urine,

arrested development of the penis, precocious sexualism, seminal weakness, spastic palsies, simulated hip-joint disease, muscular incoördination, convulsions, colic, indigestion, night terrors.

Balanitis and balanoposthitis are caused by the decomposition of the few drops of urine retained in the preputial sac. This inflammation in its turn often gives rise to warts, fissures, or adhesions.

As the opening becomes narrower through continued irritation, the salts of the urine are deposited and calculi may be formed. If at each act of micturition the prepuce "balloons," an unusual strain is thrown on the bladder, which becomes irritable.

The varied reflexes owe their existence to the exceedingly rich nerve-supply of the part. When there are distinct evidences of local irritation associated with symptoms of general nerve disturbance, the possibility of a relation between the latter and the phimosis must be carefully weighed. This by no means implies that a phimosis which excites no local symptoms can be regarded as surely the exciting cause of otherwise inexplicable nerve-storms.

ACQUIRED PHIMOSIS, when permanent, *i.e.*, cicatricial, differs from the congenital form in that the redundant skin lying in front of the preputial orifice is usually wanting, and the latter is felt as a more or less irregularly indurated band or circle, which instead of rolling back on attempts at retraction slowly stretches, tightly embracing the glans.

When temporary, acquired phimosis is due to swelling, usually inflammatory or congestive.

Treatment.—Permanent phimosis, whether congenital or acquired, should be treated by operation whenever it is responsible for local or reflex symptoms. As a prophylactic against gonorrhœa, chancroid, chancre, and cancer, the operation is desirable, even when the condition excites no trouble. The treatment of temporary phimosis due to inflammatory swelling will be described when considering the various affections which may produce this condition.

The operation of choice in phimosis is circumcision. Incision of the foreskin or stripping back will also relieve the condition.

Stripping back is applicable only in the congenital form of phimosis. It is possible in most cases. It is accomplished first by making the body of the penis as prominent as possible. Slight manipulation is in children usually followed by erection. Whether this occurs or not, the skin is pulled back as far as possible towards the root of the penis, this organ, when it is sufficiently developed, being made prominent and held in place by the ring and middle fingers of each hand, first pressed in deeply towards the subpubic angle, then brought together so that the root of the penis is grasped firmly and steadied between their tips while subsequent manipulations with the foreskin are conducted with the thumb and index finger of each hand. These manipulations consist in stripping back and tearing adhesions with the thumb-nails or in forcible sponging on the part of an assistant or in blunt dissection with a probe or grooved director. The stripping must be continued till the ring of smegma is exposed and cleaned out. The raw surfaces are then washed with weak bichloride solution (1 to 6000), dried, well greased with boric ointment, and the foreskin drawn forward. The foreskin must be retracted for washing and dressing daily for ten to fourteen days. Nor is it safe to intrust this treatment to the mother, since, when the preputial ring is tight, phimosis may be converted into what is for her an irreducible paraphimosis.

Circumcision.—This operation is indicated in every case of phimosis in children, not only because it prevents the various complications of a tight foreskin, which may interfere with growth and general nutrition, but also because it does away with the suggestion to masturbation which the irritation of a tight foreskin often gives.

In very young children the operation of circumcision is much more difficult than it is in adults. The parts are small and the tissues soft and non-resisting. The previous adhesions are usually tight, so that the glans is abraded from stripping. The application of dressings which may reasonably be expected to remain in place requires much manual dexterity. It is in infants mainly that the fault of taking off too much skin has been committed. This is avoided by marking the position of the corona with a blue pencil before beginning the operation. The most frequent error is failure to strip adhesions until the coronary sulcus is free and its contained ring of smegma is exposed. This leads to recurrent phimosis and usually to an entire failure to accomplish the object for which the operation was undertaken.

In the absence of phimosis circumcision is also indicated where there is a tendency to the formation of venereal warts, to prolonged attacks of balanoposthitis, to recurrent herpes progenitalis, to fissurings and erosions during intercourse, to hypersecretion on the part of Tyson's glands, to sexual erethism without evident cause, to apparently causeless functional disturbances of the bladder, such as nocturnal enuresis, and to masturbation.

In preparing for operation the parts are thoroughly washed with hot soapsuds, the preputial sac being cleaned by means of injections of 1 to 40 carbolic in 1 to 4000 sublimate solution. The ordinary antiseptic precautions are observed. The penis is passed through a small opening made in the centre of a sterilized towel, and the latter is then spread out, thus preventing the wound surfaces from coming in contact with the skin which has not been cleansed. The instruments required are a pair of fenestrated circumcision forceps, although the fenestra is not necessary, a knife sharpened to a razor edge, a pair of scissors which cut on the points, hæmostats, a pair of dissecting forceps, and small straight needles.

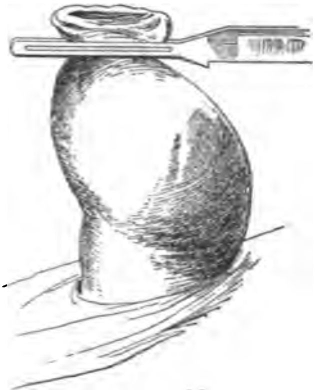
Infants and young children should be given a general anæsthetic. Adults whose prepuces can be so retracted that the mucous surfaces can be infiltrated before incision can be operated on painlessly under local anæsthesia. The solution to be employed is as follows:

℞ Cocainæ hydrochloratis or eucaine, gr. i;
Sodii chloridi, gr. iii;
Adrenalin chlorid (1 : 1000), ♏xxx;
Aquæ destillatæ, f℥i.

The syringe being filled with the solution, the needle is driven into but not through the skin, and two drops are injected, raising a white bleb. The needle is then thrust in the line of proposed incision beyond the border of the first bleb about a sixth of an inch, and two drops are again injected; this is continued from the mid-dorsal region till the frænum is reached, the injections being made into and not beneath the skin. The other semi-circumference of skin is similarly treated. Then the foreskin is retracted and its inner layer is injected in the same way, the blebs again being formed along the proposed line of incision. Finally, the loose tissue lying between the skin-layers is infiltrated, when the operation can be performed without causing the slightest pain. The objection to this method of anæsthesia lies in the fact that the necessary infiltration interferes with neat coaptation, and where the foreskin cannot be retracted it is difficult to anæsthetize the inner layer.

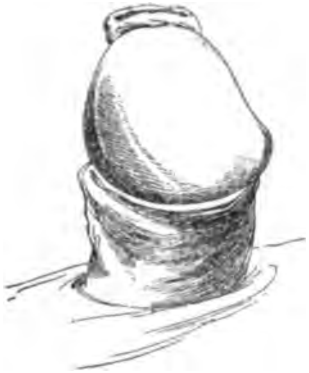
The phimosis forceps are applied loosely to the foreskin, as it lies naturally so that the fenestra is placed *just over* the prominent ridge of the corona and with its long axis parallel to this ridge,—that is, from above downward and from behind forward. Maintaining the forceps in their relative position to the skin surface by light pressure, the end of the prepuce is drawn forward and the forceps are gently closed, thus pressing the glans penis behind them. (Fig. 2.) As soon as the operator is sure that the glans is entirely behind the forceps they are closed firmly, and the prepuce is divided by carrying the knife along the fenestra. On releasing the forceps the skin at once retracts behind the corona, leaving the glans still covered with the mucous membrane; a band of integument often remains about the preputial orifice. (Fig. 3.) One blade of a pair of scissors is slipped within the latter, care being taken that the meatus is not entered, and the prepuce is split along the dorsum to within one-sixth of an inch of its reflection from the coronary sulcus. This part of the operation is sometimes difficult, on account of adhesions. These should be thoroughly stripped, as already described. The mucous membrane having been thus split and stripped, each flap of it is drawn away from the penis and trimmed off by means of the scissors (Fig. 4), leaving a circular band of mucous membrane one-sixth of an inch in width passing completely around behind the corona. Bleeding points are seized in the artery forceps and either twisted or ligated with the finest catgut. By the oblique incision just described

FIG. 2.



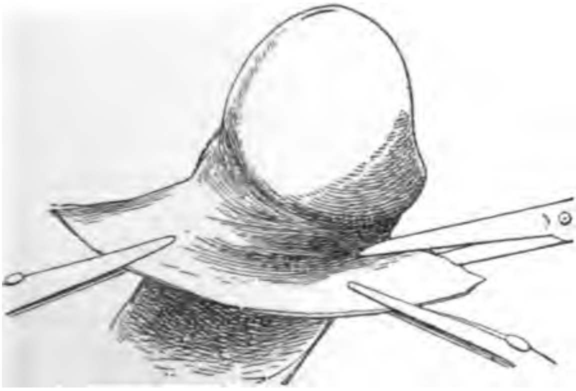
Application of forceps.

FIG. 3.



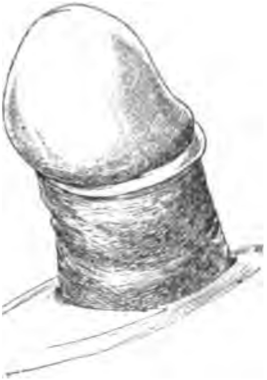
Appearance after first cut.

FIG. 4.



Trimming of mucous membrane flaps.

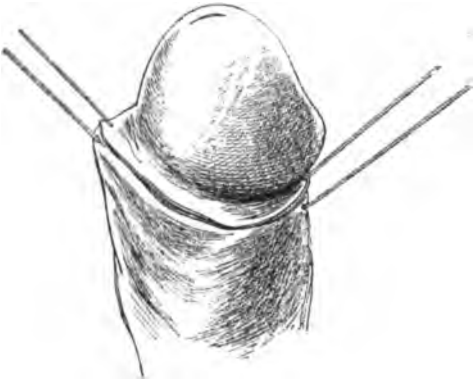
FIG. 5.



Appearance after flaps have been trimmed the frænal arteries frequently are not divided. Where there is great redundancy of tissue in this region, there should be no hesitation in removing it. When the frænal arteries are cut, it is safest to tie them. If the operation has been properly planned, the apposition between the edges of the divided skin and the remaining strip of mucous membrane will be almost perfect, so that very few sutures will be required. (Fig. 5.) The sutures employed should be of fine silk, threaded on small straight needles. In infants, fine non-chromicized catgut is best, since this does not require removal.

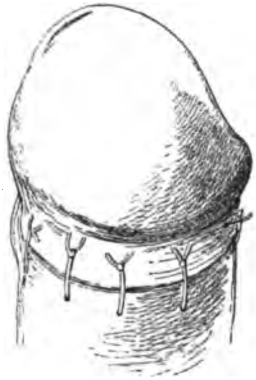
The first suture should be applied at the frænum. It includes a narrow strip of the skin at the position of the raphe, and should take a fairly deep grip on the tissues of the frænum. As it is tightened, care must be taken that the skin is not inverted. This cannot well happen if the needle is inserted near its cut edge. The next stitch is inserted in the mid-dorsal region. (Fig. 6.) A stitch on either side midway between the two already described is often sufficient, though in adults it is safer to apply a complete row of sutures, since the irritation incident to the operation often occasions erection, which may tear loose the feeble adhesions formed in the first few hours. (Fig. 7.)

FIG. 6.



Insertion of first and second sutures.

FIG. 7.



Operation completed.

The dressing may be either dry or wet. In the dry dressing the line of incision is dusted with iodoform or acetanilid, then covered with a thin narrow strip of sterile gauze, and over this is painted *fresh* iodoform collodion. In using this dressing, which is applicable only to such cases as are likely to heal by first intention,—*i.e.*, those operated upon under circumstances most favorable for the observance of rigid asepsis and not complicated by previous inflammation,—the strip of dry sterile gauze first applied to the wound must extend to but not across the coronary sulcus. This is then secured in place by painting on sufficient collodion to make an occlusion dressing. The penis is then wrapped in absorbent cotton, and bandaged in the erect position against the pubis and lower belly surface either by the crossed of the perineum or the "jock-strap," and the patient is allowed to be up and about.

The wet dressing will in the long run give the most satisfactory results. A narrow strip of lint or gauze sixteen inches long, split at one end, is dipped into an antiseptic solution (phénol sodique one part, water five parts, or boroglyceride, twenty-five per cent., one part, water three parts), and secured in place by tying the split ends. This dressing is kept wet by the antiseptic solution, which is dropped on at short intervals. In children it is maintained in place by the pressure of the diaper. The latter should be perfectly clean, since the wet strip is liable to drop off and thus allow of wound infection. Healing should take place by first intention in from four to seven days. The stitches can be removed on the fifth day, and after that the line of incision may be dressed with a narrow strip of lint coated with a thick layer of boric ointment and held in place by adhesive plaster, or the dressing may be of gauze and collodion.

Instead of the wet dressing an ointment may be used, and this is particularly serviceable when extensive stripping has left the glans raw and sensitive and readily adhering to any fabric, such as gauze, which is brought in immediate contact with it. After the operation is completed a T-bandage is applied, with the T in front and an opening properly placed in the vertical strip below the waistband to admit the penis. A piece of lint backed by a piece of thin gutta-percha is cut in the shape of a Maltese cross, with a perforation in the centre for the meatus urinarius, and of such size that the limbs of the cross, when the meatus is placed at this opening, reach to the peno-scrotal junction. The gutta-percha tissue and lint are basted together. The lint side is then thickly spread with recently sterilized boric ointment, and closely applied to the penis. Finally, a gauze bandage holds the dressing in place and is secured to the T by safety-pins. This dressing should be changed two or three times a day, or otherwise it will become dry and adherent.

The complications of circumcision at the time of operation are hemorrhage and œdematous swelling of the loose cellular tissue, particularly that near the frænum.

Hemorrhage is easily controlled by the forceps. They should pick up the bleeding vessels with as little surrounding tissue as possible, and every bleeding point should be secured. The œdematous infiltration readily subsides in the after-treatment under the use of cold evaporating lotions. This rapid œdema is troublesome mainly because it interferes with coaptation; sometimes as many as twenty or thirty sutures are required before the cut edges can be brought together accurately around the entire line of incision. In such cases it is well to employ the continuous suture, interrupting it after four or five stitches have been taken. Thus the neatest apposition may be secured in even the most troublesome cases.

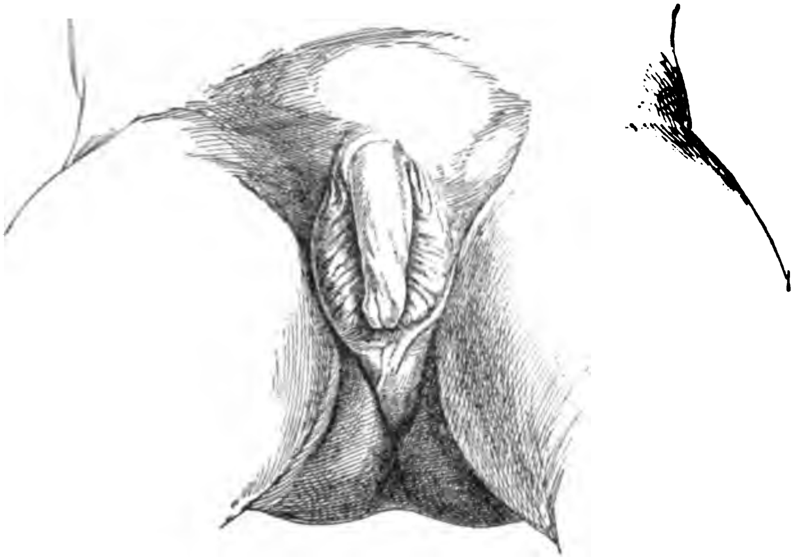
Consecutive hemorrhage from the frænal arteries is sometimes severe. When these arteries have not been tied, a moderately tight bandage should be applied, and directions should be given the nurse to watch for either rapid swelling and discoloration of the penis or external bleeding. When the line of suture has been tight, the blood may be extravasated into the cellular tissue, causing enormous swelling, and, in case of concomitant infection, extensive sloughing.

The treatment consists in opening the wound, securing the bleeding vessels, and evacuating as much of the clot as possible. Evaporating and antiseptic lotions, such as lead water and alcohol, subsequently may be applied.

Œdematous swelling coming on after the operation is completed is usually dependent upon bleeding, though it sometimes develops when hæmostasis has been absolute. It is commonly due to the use of irritant antiseptics, though it may occur without assignable cause. It subsides, in part at least, in from one to two days under elevation, the application of evaporating lotions, and the administration of a brisk purgative. It often persists for months in the form of a semisolid œdema about the frænum. In nearly all cases this disfiguring swelling ultimately disappears entirely. This may be hastened by the application of stimulating and absorbent ointments, such as thyol or ichthyol ten parts, and lanolin one hundred parts.

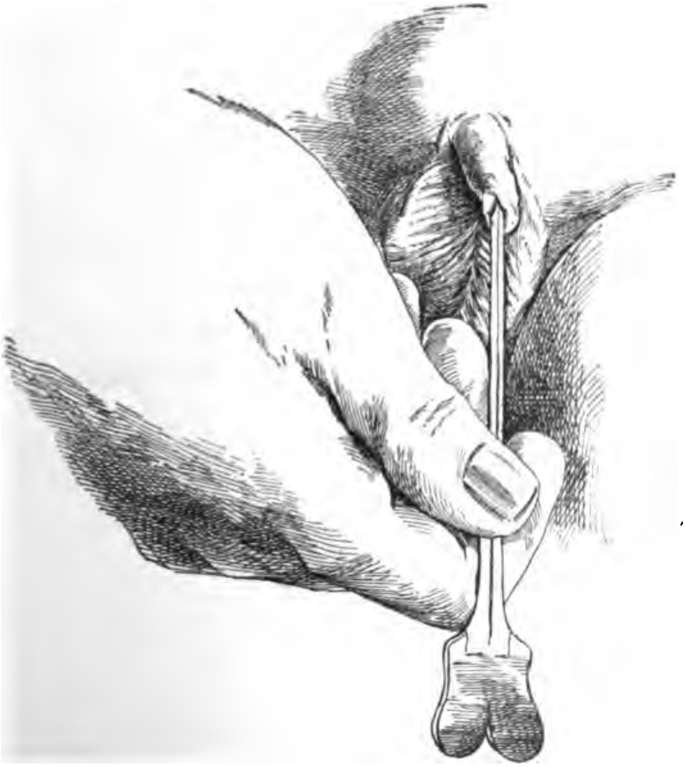
Infection.—When through a lack of care in antiseptic precaution, or because of operation on previously infected tissues, the wound becomes infected, swelling is rapid and extensive, and all the symptoms of local inflammation are marked. Under these circumstances it is best to provide for drainage by the removal of stitches where the line of suture has been tight. The infected tissue should be washed with hydrogen peroxide, followed by bichloride 1 to 2000, or carbolic 1 to 40, solutions, and should be wrapped in an antiseptic and cooling wet dressing, unless the inflammation is of such high grade that the vitality of the parts is threatened. In this case large hot antiseptic fomentations are indicated, together with treatment appropriate to acute inflammation. This complication of phimosis is rarely encountered, except when the operation is performed during the course

FIG. 8.



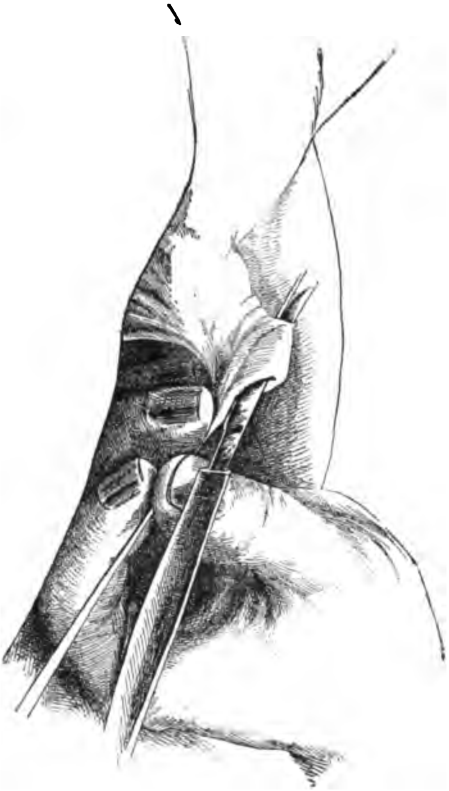
The appearance of the penis in a case of phimosis.

FIG. 9.



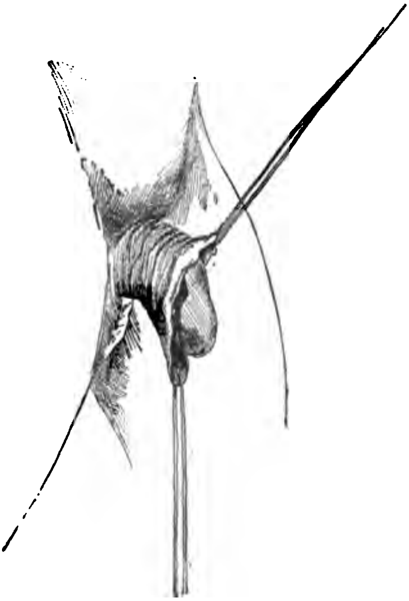
A grooved director is introduced beneath the prepuce in the median line on the dorsal surface

Fig. 10.



A knife is passed along the grooved director and its point brought out ready to split the prepuce in the median line.

Fig. 11.



The skin and mucous membrane have been trimmed off with scissors and the first two sutures have been introduced, one at the frænum and the other in the median line of the dorsal surface of the penis.

of an acute inflammatory attack. Under such circumstances circumcision should not be undertaken unless the indications for it are imperative.

Interference with Erection.—This results from the removal of too much skin. The operator may fail to notice the relations between the skin surface and the deeper parts, but, seizing the prepuce and drawing it forward as far as possible, may apply his phimosis forceps, make his cut, and find that he has denuded the penis almost as far back as the scrotal junction. In this case, after healing marked distortion or incurvation of the penis may for a time occur on erection; but, owing to the great extensibility of the skin, the ultimate prognosis is good; at times the frænum will require division.

Recurrence of the Phimosis.—When too much of the mucous layer of the foreskin has been left, phimosis may recur in a more severe form than that for which the original operation was undertaken, the cicatricial tissue along the line of suturing sometimes contracting very rapidly. A strip of mucous membrane wider than a fourth of an inch should never be left. If narrower than a sixth of an inch, it is somewhat difficult to insert the sutures satisfactorily.

A method of performing circumcision, popular because of its simplicity, requires simply scissors, curved bistoury, grooved director, artery forceps, and needle and thread. The grooved director is passed through the preputial orifice back to the coronary sulcus. It is moved from side to side to make sure that it has not entered the meatus, palpation with the fingers showing that its extremity passes over the surface of the glans and does not cause this body to follow its motions. The curved bistoury is passed along the groove of the director, and its point is brought out through the dorsum of the prepuce. By cutting forward and upward with the knife the prepuce and its mucous layer are split. By means of the scissors one of the tabs of skin and mucous membrane is trimmed downward and forward to the meatus, leaving a width of not over one-sixth of an inch of mucous membrane. The other tab is trimmed off in the same manner, and sutures are applied. (See Figs. 8, 9, 10, 11.)

This operation has the advantage of removing skin and mucous membrane together and dispensing with the phimosis forceps. It is the method of choice in those cases of inflammatory swelling and exudation in which the prepuce cannot be drawn forward and the fenestrated forceps cannot be applied.

Paraphimosis.—When the prepuce has been retracted behind the glans and cannot again be brought forward, the condition is termed paraphimosis. The exciting cause is usually a more or less forcible retraction of a tight foreskin, though occasionally inflammatory swelling will cause the foreskin to roll back.

In gonorrhœa, chancroid, chancre, balanoposthitis, and all lesions of the genitalia attended by swelling of the glans or the foreskin, this complication is particularly liable to occur. It is most frequently observed in children as a result of manipulation of the parts.

When a narrow preputial orifice is drawn behind the corona the constriction it exerts upon the parts causes rapid swelling. The glans becomes markedly enlarged and glossy. It is often partially concealed by a thick collar of shiny œdematous mucous membrane, behind which there is a deep excoriated sulcus, and back of this sulcus there is usually a second œdematous band less marked than the one lying immediately behind the coronary sulcus. The penis seems to have a distinct upward kink or bend just behind the glans. This appearance is due to the deep notch caused by the margin of the retroverted preputial orifice of the penis, and to the œdematous swelling which is particularly marked about the position of the frænum. In some cases, where the tense inelastic edge of the orifice exerts a more than usual amount of constriction, circulation is markedly interfered with, and ulceration and even sloughing involving both the foreskin and the head of the penis may take place. This complication would undoubtedly be more frequent were it not for the rich blood-supply to the glans and the anastomosis between its vessels and those of the corpora cavernosa. The ulceration usually involves the foreskin only.

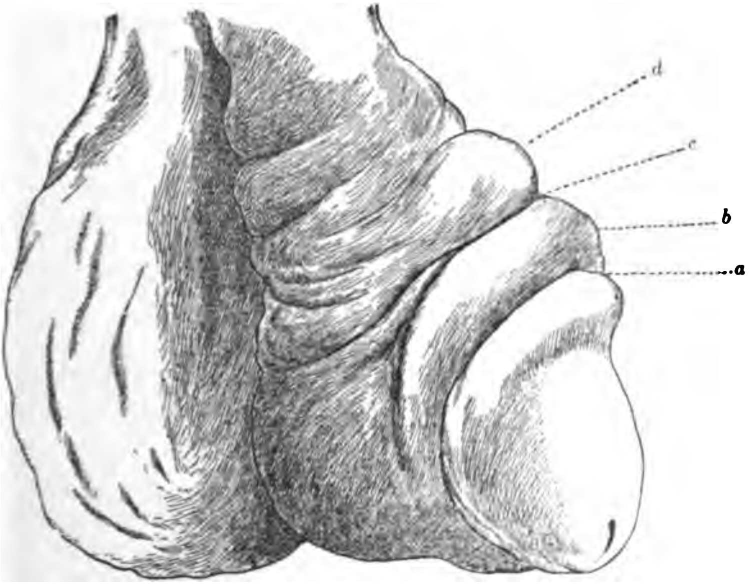
When the swelling consequent upon paraphimosis is well developed (Fig. 12) there is encountered first a furrow (*a*), the coronary sulcus, which is normally found behind the corona; in these cases it appears deeper because it is intensified by the œdematous swelling. Covering this furrow, and even overlapping the glans somewhat, is a shiny œdematous collar of mucous membrane (*b*). This is that portion of the prepuce which is normally in contact with the posterior face and border of the corona. Behind this swollen fold is found a second deep, often ulcerated furrow (*c*); this is the actual seat of constriction, and behind it is placed yet another ridge of swollen integument (*d*).

Paraphimosis is attended with very severe pain, which does not intermit until the constriction has been relieved, either by operation or by the process of ulceration. Where surgical interference is delayed, or has not been successful in remedying the trouble, the subsequent cicatricial contraction may occasion great deformity.

Treatment.—The treatment of paraphimosis is, of course, reduction. This should be effected at once, except in those cases where paraphimosis is the result of a previously existing inflammation and is not occasioning sufficient interference with circulation seriously to complicate the original lesion. For instance, patients with a short foreskin suffering from chancroid frequently have the foreskin rolled back. and, as a consequence of œdema following the original lesion, cannot bring it forward again. In such cases the paraphimosis is a result, not a cause, and frequently occasions no circulatory disturbance. Treatment of the original lesion, together with evaporating lotions, rest, and elevation of the part, will bring about a cure. All such cases should, however, be carefully watched, and should be operated on at the first sign of strangulation.

When paraphimosis is of sudden development and not dependent upon œdema consequent upon a pre-existing lesion, it should be reduced at once, whether symptoms of strangulation are present or absent. If the glans penis is purple, black, or mottled in color, cold, and non-sensitive, the indications for interference are still more urgent. Here no time should be lost in efforts at reduction by mechanical means. The constricting band should be divided, the foreskin drawn forward, and the vitality of the parts restored as far as possible by the long-continued application of hot compresses wrung out in mild antiseptic lotions and changed every few minutes.

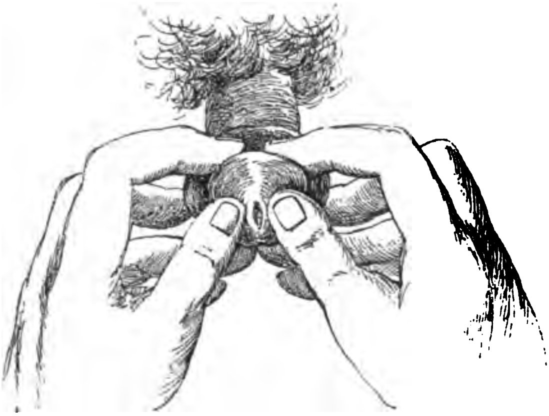
FIG. 12.



Paraphimosis.

Reduction is easily accomplished if the case is seen before œdema has become very marked. When there is no fear for the vitality of the part, an ice-bag may be applied to the penis for half an hour. Ether should then be administered, the thick œdematous collar, the greatest obstacle to reduction, should be punctured in many places by means of an ordinary surgical needle, and the anterior and inner surface of this collar and the corona glandis should be lubricated with carbolized oil. The surgeon then seizes the penis just behind the seat of constriction between the lateral surfaces of the middle and ring fingers of both hands, and while the two thumbs and index fingers press upon the glans penis, not pushing it backward, but squeezing it and drawing it slightly forward, the fingers endeavor to draw the prepuce over the thus narrowed and elongated glans.

FIG. 13.



Reduction of paraphimosis.

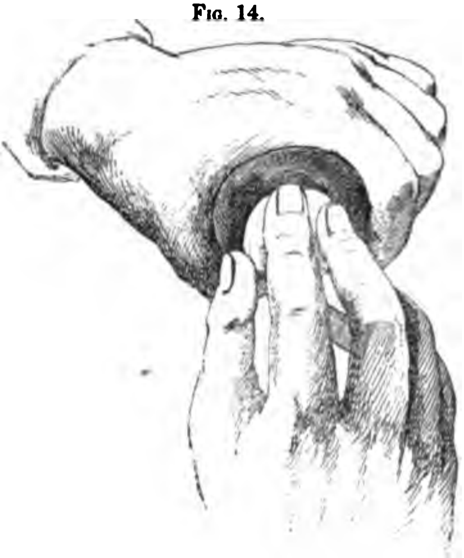
(Fig. 13.) Backward pressure with the thumbs has the effect of making the base of the glans broader, and thus effectually prevents reduction.

Reduction may also be effected by grasping the penis in the left hand, as in seizing a rope, the thumb and forefinger being applied behind the seat of constriction. The fingers and the thumb of the right hand are applied to the glans penis, which is compressed laterally and drawn slightly forward, while an effort is made to carry the strictured part clear of the corona glandis by exerting traction with the left hand. (Fig. 14.)

When these manipulations fail, a rubber band may be wound about the glans, covering it in completely from before backward. This so reduces the glans in size that the end of a grooved director or the handle end of a scalpel can usually be passed beneath the constricting band. When that is accomplished the rubber band is removed, and by means of the instrument introduced beneath the constriction reduction is readily effected.

When these measures prove unsuccessful, the constriction must be divided. This can be done by pulling the collar of œdematous mucous membrane downward towards the glans as far as possible, thus exposing the constricting band, which is divided in one or more places by a sharp scalpel. It must be borne in mind that the constriction usually lies behind the œdematous collar of mucous membrane which covers and conceals the coronary sulcus.

FIG. 14.



Reduction of paraphimosis.

Exceptionally, when the prepuce is merely retracted instead of being rolled back, and slips up without turning over, the preputial ring grasps the penis immediately behind the corona. This may be compared to pulling up a tight coat-sleeve instead of turning it up. If in such a case there be sufficient constriction to occasion strangulation, the thick collar of œdematous mucous membrane will be wanting, and the constricting band will lie in the coronary sulcus, where it can readily be divided by inserting beneath it a grooved director, guided by which an incision with a curved bistoury can be made.

The incision must be sufficiently free to allow of easy reduction. Sometimes where enough time has elapsed for the formation of inflammatory adhesions two or three incisions are necessary.

Reduction should be complete. In cases of marked œdema after prolonged manipulation, the congested fold of mucous membrane may be pulled completely over the glans, simulating reduction when in reality this has not been effected. This is particularly the case in children who, if unanæsthetized, by their struggles prevent the surgeon from appreciating the distinct and sudden slip which denotes reduction. When the paraphimosis is properly reduced the glans disappears entirely and can be exposed only by forcibly drawing the foreskin backward.

Under certain circumstances the surgeon may be compelled to resort to palliative measures. The fears of a patient, in the case of a child the anxiety of parents, or the comparative mildness of symptoms, may justify the application of pressure. This may be applied by means of adhesive straps or by a bandage. Straps, if used, should be narrow and so applied that uniform pressure is exerted. The resin plaster should be employed. The penis is completely covered in by strips placed longitudinally, the first running from the middle of the upper surface of the organ to the middle of the under surface, and the others being applied so that each overlaps its predecessor. Then circular straps are applied, running from the extremity of the penis backward, the meatus being left free. In a day there is usually sufficient diminution of swelling to permit reduction.

After incision and reduction the parts should be wrapped in a bandage kept continually wet with dilute lead water, or with phénol sodique and water equal parts, or with lead water and alcohol, till the swelling subsides, when the wound may be dressed with powdered iodoform or boric acid ointment.

Solid œdema of the foreskin sometimes persists for weeks or months. In this case circumcision is advisable, though the persistent use of pressure, supplemented by applications of ichthyol ointment (ten per cent.), will ultimately cause the disappearance of the swelling.

Shortness of the Frænum.—This congenital deformity in certain cases interferes with complete erection of the glans, turning the orifice of the meatus downward, and not only preventing ejaculation in the proper direction, but also rendering sexual intercourse painful, or even impossible.

The treatment is simple and efficient. The frænum is put upon the stretch, a narrow bistoury is thrust through its base, and by an incision from within outward the bridle of skin is cut completely through. The prepuce is kept retracted until the healing is complete.

INJURIES OF THE PENIS.

Contusion.—This implies an injury by crushing force without lesion of the skin. The phenomena attendant upon such an injury do not differ from those following similar traumatisms in other parts of the body. Owing to the looseness of the cellular tissue, ecchymosis and œdema are often so pronounced as to simulate rapid gangrene.

When the vessels of the cavernous bodies are involved there is free subcutaneous bleeding, giving rise to a circumscribed fluctuating tumor, most prominent during erection. This tumor is somewhat slow in forming, and occasionally suppurates. Under conservative treatment it usually disappears. When injury has not only occasioned extensive extravasation of blood, but has lacerated the urethral canal, the inflammatory phenomena observed after rupture of the urethra quickly develop. (See page 91.) Moreover, there is immediately bleeding from the meatus, which should lead to prompt diagnosis and appropriate treatment.

Treatment.—The treatment of contusions of the penis is conducted on general principles,—rest, elevation, pressure by narrow gauze bandages, the application of evaporating lotions, and, for the purpose of hastening absorption, gentle massage.

Extensive swelling and discoloration need not occasion anxiety, unless there has been rupture of the spongy or cavernous bodies or of the urethra. When gangrene is threatened on account of the severity of the lesion or because of interference with circulation occasioned by the pressure of effused blood, hot antiseptic fomentations frequently repeated are indicated. These dressings are made by wringing fifteen or twenty layers of antiseptic gauze out of a hot 1 to 10,000 bichloride solution. They may be covered with waxed paper to prevent evaporation. If the symptoms are still progressive, free incision and ligation of bleeding vessels, followed by suture of the wound, are indicated. Emphysema is always a serious symptom, and usually calls for free incision, as it probably results from infection with saprophytic organisms in addition to those of suppuration.

On the first sign of suppuration after contusion, incision should be made sufficiently free to secure thorough drainage.

Wounds of the Penis.—These are classified according to general surgical principles as incised, lacerated, punctured, and contused.

Incised wounds, if superficial, are readily closed, and heal quickly. Deep wounds, that is, those involving the erectile tissue, bleed freely, and, if transverse and extensive, are liable to be followed by loss of erectile power in the tissue lying anterior to the wound. When the penis is completely divided, hemorrhage is so rapid that, unless it is promptly arrested, a fatal issue is probable.

Treatment.—The treatment of these wounds is conducted on general principles. Violent hemorrhage is checked by ligatures: the surfaces are brought in apposition and held there by sutures passed through the fibrous sheath of the erectile tissue, but no deeper. This simple fixation is usually sufficient to stop the venous oozing. If not, a stiff English catheter is passed into the urethra, and a pressure bandage is applied for some hours. Inflammatory reaction always excites erection. This interferes with primary healing, and should be prevented by full doses of bromide (ʒiii daily), by opium and belladonna suppositories, or by hypodermics of morphine. Even if the penis is almost completely severed, hanging by a small strip of tissue, an effort should be made to suture it in place. When the penis is completely cut off, the bleeding vessels are tied, the cavernous bodies are covered in by suture of their fibrous envelopes, the skin is drawn forward and sewed over the closed ends of the corpora cavernosa, and the urethra is split and secured to the skin to prevent subsequent stricturing of its orifice. (See page 66.)

When the urethra is divided it should be sutured, and the urine should be drawn by a small soft catheter. Intermittent catheterization is practised for five days, the instrument at each passing being attached to a fountain syringe and being introduced with a stream of protargol (1 to 2000) flowing through it. After the bladder is emptied, the fountain syringe is again attached to the catheter, and as the latter is withdrawn the anterior urethra receives another antiseptic washing. When the introduction of the soft catheter is excessively painful, a different continuous catheterization should be practised. (See page 311 *et seq.*) If, as a result of cicatrization following wounds, erection is complete but there is deviation of the penis from a straight line, cure by operation may be successful. When, however, there has been obliteration or obstruction of the spaces of the spongy and cavernous bodies, producing deviations and incomplete erections, treatment is unavailing.

PUNCTURED WOUNDS of the penis, when inflammatory symptoms are pronounced and infection is probable, should be converted into incised wounds, cleansed, and drained from the bottom.

CONTUSED AND LACERATED WOUNDS of the penis are particularly dangerous only when the urethra is involved or the injury is so great as to devitalize tissues. When extensive they are liable to be followed by imperfect erection or by distortion of the penis. The treatment consists in subduing inflammatory phenomena. Bleeding in these cases is moderate; when the urethra is involved permanent catheterization is practised. Sometimes the catheter cannot be introduced till the urethra is opened behind the seat of injury, and then the position of its proximal end in the wound is determined by passing an instrument from behind forward.

GUN-SHOT WOUNDS of the penis partake of the nature of contused and lacerated wounds, are subject to the same complications, and require similar treatment. The shot or bullets, if embedded in the erectile tissue, should always be removed, and every possible portion of the penis should be preserved.

Fracture of the Penis.—This injury, possible in a literal sense only when the penis has undergone *calcification*, occurs when during vigorous erection the organ is subjected to a sudden twist or bend. The cause of the injury is usually a false movement in coitus, though a wrench or a blow will also produce it, as, for instance, when the penis is caught in closing a bureau drawer, or is bruised by a falling window-sash. Demarquay states that it occurs mainly in those suffering from a partial calcification of the fibrous sheath of the penis. The foolish custom of "breaking" a chordee, at one time quite frequent among venereal patients, occasioned a number of cases of this injury.

Symptoms.—The symptoms of this injury are sudden severe pain and a sense of something having given way, consequent on a bending or twisting strain of the erect penis. The erection subsides at once, and there is rapid and immediate swelling. Deformity, unless masked by the swelling, is pronounced. The part of the penis anterior to the break is preternaturally movable, and at the seat of injury there is an angle producing a flail-like appearance.

Prognosis.—The prognosis is only moderately good. The subcutaneous effusion of blood may possibly cause so much tension that gangrene will be threatened. This, however, is rare, and under proper antiseptic treatment suppuration will not occur, except when the spongy body and urethra have been involved in the injury and there is extravasation of urine.

The prognosis as to functional restoration must always be somewhat guarded. In some cases this apparently has been perfect. In others there has remained an indurated mass at the seat of injury, which has seriously interfered with erections and has resisted all treatment.

Treatment.—Rest in bed, the firm bandaging of the penis in the erect position against the abdomen, the application of evaporating lotions, and, if needful, drawing the water by catheter (see page 24) usually will be followed by arrest of hemorrhage and gradual absorption of clot.

When the blood effusion forms a large tumor, and particularly when the hemorrhage continues, threatening by tension the vitality of the part, an incision must be made, thus allowing ligature of the bleeding vessels and accurate suture of the torn fibrous sheath. Pressure is applied by bandaging the penis against the abdomen. Erections are prevented by keeping the bowels opened and by giving full doses of potassium bromide (ʒii to ʒiv daily).

Dislocation of the Penis.—This accident is produced by traumatism exerted upon the anterior portion of the flaccid organ. The penis is pinched out of its sheath and driven into the scrotum, the loin, or the neighboring regions, much as a grape is squeezed out of its skin. The mucous layer of the prepuce, which should prevent this accident, gives way either at the preputial orifice or, more commonly, along the line of the coronary sulcus. The urethra is usually ruptured in the perineal region.

Symptoms.—The symptoms of this accident are not so marked as would be supposed. The skin sheath of the penis is often filled with clotted blood, thus simulating the presence of a shrunken organ. There is usually free hemorrhage from the preputial orifice. Later there is extravasation of urine, with its concomitant symptoms. Careful investigation will always show the absence of the erectile tissues from their proper position and their presence elsewhere.

Treatment.—The treatment consists in immediate replacement of the organ. This usually requires an incision, though in one reported case the penis was hooked forward by an instrument introduced into the preputial orifice. There should be no hesitation in making the required incision so free that the proper manipulations for reduction can be easily carried out. After this, if there has been extravasation of urine, an external perineal urethrotomy should be performed.

INFLAMMATORY AFFECTIONS OF THE PENIS.

The penis and its envelopes are subject to the inflammations observed in other parts of the body. Aside from the distinctly venereal diseases, eczema, dermatitis (notably that from ivy poisoning), pruritus, urticaria, erythema intertrigo, the bites of insects, parasitic diseases, herpes, erysipelas, lymphangitis, folliculitis, abscess, diffuse cellular inflammation, and gangrene are to be noted.

Eczema very commonly affects both the scrotum and the penis, and is extremely rebellious to treatment. The exciting cause is often chafing or rubbing of the parts, though a constitutional dyscrasia, such as gout or rheumatism, commonly predisposes to the disease. It usually appears on the prepuce or about the base of the penis.

The treatment is the same as for the disease situated in other parts of the body, except that, as the skin is extremely sensitive, irritating applications must be avoided.

Herpes of the entire penis is rare; it usually attacks the foreskin and glans. (See page 33.)

Acute inflammation of the penis may be localized or diffuse. It may involve the subcutaneous cellular tissue or the structure of the erectile tissue. Localized inflammation results in abscess. This is treated in accordance with general principles, whether it be superficial or placed in the substance of the organ,—*i.e.*, it is opened and drained.

The diffuse inflammation may appear in the form of erysipelas of the subcutaneous tissues, or may attack the substance of the erectile tissue, constituting the affection called *penitis*. Elevation and the application of evaporating lotions are indicated, followed by incision and drainage should there be pus-formation.

Gangrene occasionally results from deep-seated acute inflammation, which may be due to local causes, such as phimosis or paraphimosis, traumatism, or urinary extravasation, or may develop as a result of thrombosis after acute fever, such as typhoid, or may be incident to diabetes. The trophoneurotic gangrene secondary to cord lesions is guarded against by dry cleanliness and the avoidance of pressure.

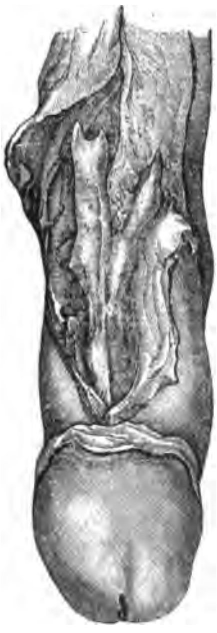
Treatment.—The treatment of gangrene of the penis is that applicable to this condition in other parts of the body. In case the gangrene is rapidly spreading, removal of the dead tissue by scissors and curette, supplemented by thorough application of the actual cautery, is indicated. Compresses soaked in hot bichloride solution (1 to 10,000) and changed every half-hour are applied till healthy granulations form, when boric ointment, or a dry dusting powder, such as iodoform, or acetanilid, may be substituted.

When gangrene is less fulminant in type, hot compresses, changed every three minutes (bichloride solution 1 to 10,000, at a temperature of 110° F.), may be applied for twenty-four hours, supplemented by thorough spraying of the involved parts with peroxide solution every two hours. When the gangrene is distinctly slow in type and resists ordinary treatment, a long-continued general bath or hip bath is indicated. This should be kept comfortably hot and should be mildly antiseptic (ʒss bichloride, or ℥xii boric acid, to the bath). The genitalia should be kept submerged day and night for days, and even, in exceptional cases, for weeks. Many of these cases of indolent gangrene are late manifestations of tertiary syphilis in persons afflicted with visceral disease. This is shown by the fact that a vigorous course of inunctions and potassium iodide will at times cause the rapid healing of necrotic lesions which have for weeks or months proved absolutely rebellious to every other form of treatment.

The systemic treatment is extremely important in all cases of gangrene. This must be tonic and stimulating. Easily digestible food in as full quantity as can be given, tonics, particularly iron, strychnine, and small doses of bichloride (grain one-sixtieth thrice daily), and stimulants are indicated. The bowels should be moved regularly. Diabetic gangrene should receive appropriate constitutional treatment.

Chronic inflammation of the erectile tissue and its fibrous envelope, particularly of the corpora cavernosa, results in slow, often painless, areas of induration, which may be fibrous, calcareous, or even bony (Fig. 15), and which require attention only because they prevent complete erection. The cause of these indurations is unknown. They are observed in middle-aged men, and are often associated with the rheumatic and gouty diatheses. They have been regarded as late lesions of syphilis. With this disease they probably have no relation, though it must be remembered that gummata may appear in the corpora cavernosa.

FIG. 15.



Osseous growth of the penis. (Demarquay.)

Symptoms.—The symptoms of this affection are sufficiently characteristic. Palpation demonstrates one or more circumscribed, hardened, possibly tender areas, varying from the size of a split pea to that of the thumb-nail. The erect penis is bent at the seat of hardening, and often erection is incomplete in the portion of the involved cavernous body lying to the distal side of the lesion.

Treatment.—The treatment of this affection is without avail. In the early stages, when slight constant pain and beginning hardness indicate the nature of the case, pressure by means of a thin rubber bandage, inunctions of mercuric ointment, and the internal administration of potassium iodide and wine of colchicum root, continued for many months, may prevent permanent crippling. When the lesions are fully formed the same treatment may be tried, but with slight prospect of success. When a calcareous or a bony plate materially interferes with functional activity and is placed superficially, there can be no objection to removing it by a cutting operation, but the operator should hold out no definite hope of restoration of function.

Inflammatory lymphangitis is secondary to peripheral inflammation, sometimes non-specific, but usually of venereal origin.

Symptoms.—The inflammation usually affects the lymphatics of the dorsum of the penis. Beneath the skin can be felt one or more cords, often starting about the region of the frænum and passing upward and backward behind the corona to the dorsum of the penis, along which a distinct cord can be felt extending as far back as the symphysis pubis. This cord is tender, hard, not very sharply circumscribed, and over its course the skin is reddened and sometimes adherent. This line of induration may attain the size of a lead-pencil, and may even be much larger than this. It is attended with a great deal of pain, which is especially severe during erection. Exceptionally an indurated knob forms sometimes just behind the corona in the loose subcutaneous connective tissue, sometimes in the course of the dorsal lymphatics; this slowly enlarges, giving comparatively little pain, softens, and on being opened discharges pus. From this a persistent fistula may result which can be cured only by extirpation.

Gonorrhœal lymphangitis may be distinguished from that which characterizes hard chancre by the fact that its outlines are not sharply circumscribed, the inflammation commonly extending to the surrounding cellular tissue, and by its being tender and painful, and involving the skin and producing the redness and œdema characteristic of acute inflammation.

It would be extremely difficult to distinguish lymphangitis from dorsal phlebitis. This latter complication of inflammatory affections of the urethra, glans and foreskin, if it ever does occur, is certainly exceedingly rare. It would be necessarily attended by much more swelling of the penis, and would not be accompanied by that enlargement of the lymphatic glands of the groin which is rarely absent when lymphangitis of the penis is observed. Moreover, the vein passes backward in the middle line, and is not deflected towards the groins as is the case with the lymphatic vessels, and is placed more deeply so that it cannot be lifted up with the skin.

Treatment.—Free drainage of pus from the anterior urethra, appropriate treatment directed towards lessening the severity of the urethritis, and careful cleansing of the preputial sac are matters which should receive close attention. Following these, rest should be enjoined, the bowels should be opened, and continuous applications should be made of cloths kept wet with alcohol and lead water equal parts. Hot baths, local or general, are also serviceable, and when the erections become troublesome potassium bromide should be given in sufficient doses to control them. This drug failing, hypodermics of morphine may be given at night to procure rest. When pus forms it should be evacuated by incision, the remaining cavity being curetted and packed from the bottom.

In a very rare form of lymphangitis the lymphatic vessels of the prepuce are dilated without marked inflammatory phenomena. The symptoms of this affection usually appear after coitus or other cause of acute congestion. On retraction of the prepuce the congested, semi-transparent lymph-vessels are easily detected, passing upward and backward from the frænum towards the dorsum of the penis. The swelling subsides in a few days, but recurs after each attempt at coitus, until finally it becomes permanent. When the swollen vessels are unduly prominent, mechanical disturbance is followed by marked symptoms of local inflammation.

The treatment in the early stages consists in prolonged hot local baths and the use of astringents. Fluid extract of hamamelis, one part to four parts of water; ammoniated mercurial ointment, ten grains to the ounce of carbolated cosmoline; ointment of belladonna and mercury, one part to four parts of lanolin, well rubbed in; or compresses kept wet in lead water and laudanum, will often effect a cure.

When the dilatation becomes permanent surgical interference is necessary. A seton passed through the enlarged vessel or excision of a portion of its length will be followed by a temporary increase of swelling, but ultimately by obliteration and cure.

Phlebitis occurs secondarily to other lesions of the penis or urethra. A dense indurated cord is felt along the course of the vein, and there is great swelling. Suppuration is rare, and treatment by evaporating lotions and rest and catharsis is usually efficient.

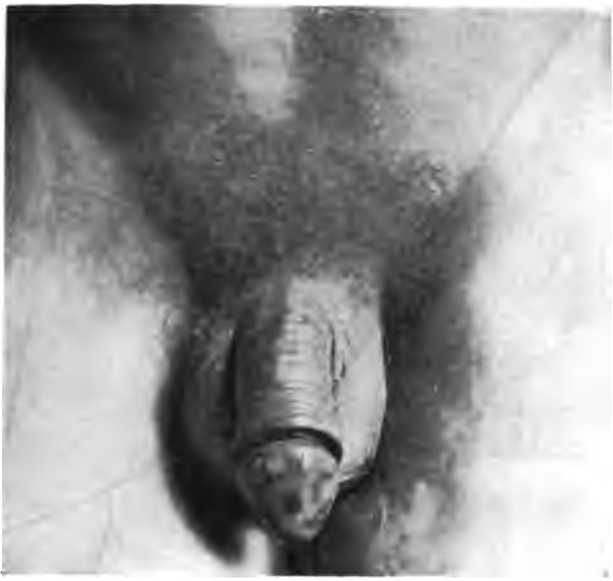
VARICOSE VEINS of the penis are frequently observed, either as a local expression of general venous dilatation or independently of other lesions of a similar kind and as a sequel of inflammation. Usually they occasion no inconvenience. When they are so large as to interfere with coitus, cure may be effected by ligation or by excision.

The inflammatory affections which most frequently involve the glans and prepuce are balanitis, balanoposthitis, and herpes progenitalis.

Balanitis and Balanoposthitis.—Balanitis is an inflammation of the surface of the glans penis. Balanoposthitis is an inflammation of both this surface and the mucous layer of the foreskin. Posthitis is, of course, an inflammation of the mucous layer of the foreskin alone. They may be considered together.

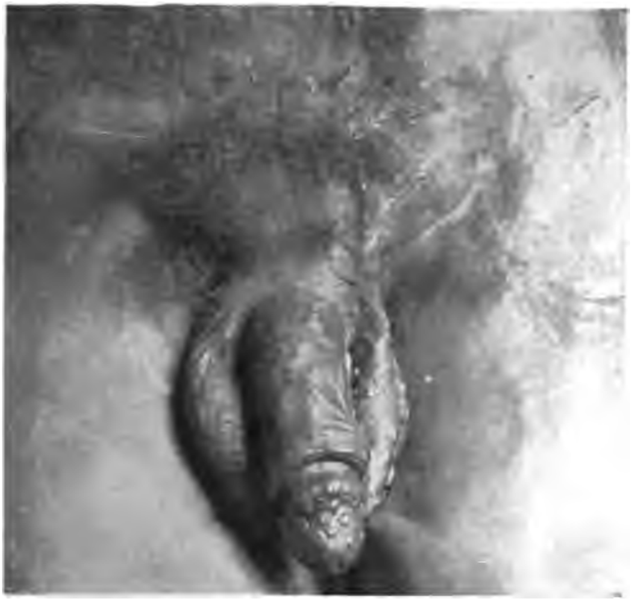
Causes.—The principal predisposing cause of these inflammations is a redundant or phimotic foreskin. This keeps the apposed mucous surfaces macerated and irritated, favors retention and consequent decomposition of smegma and urine, and offers conditions most propitious to a successful inoculation when specific virus is introduced

Fig. 16.



Balanitis.

Fig. 17.



Herpes of the glans.

within the preputial sac. The gouty or rheumatic diathesis and diabetes also predispose to this form of inflammation.

The exciting causes are either mechanical, as from friction or abrasion, or chemical, as from contact with irritating discharges, like those from chancre, chancroid, or gonorrhœa, or from non-specific lesions, as endometritis. The pus cocci and the colon bacilli are the usual causative factors.

Symptoms.—The symptoms of balanitis in its mildest form, the form from which most men who are not careful as to local cleansing suffer at times, are a sense of heat and itching about the end of the penis, some redness and swelling near the preputial orifice, a discharge which crusts and is extremely offensive, and on stripping back the foreskin a hyperæmic infiltrated mucous membrane exhibiting on its surface a thick, creamy deposit, and at times patches of superficial excoriation. (Fig. 16.) In the coronary sulcus is found an abnormal quantity of semi-liquid, offensive smegma.

In severe cases the excoriations are extensive and well marked, inflammatory phenomena are more pronounced, and the whole prepuce becomes greatly swollen, and in consequence phimotic (inflammatory phimosis). The discharge is profuse. This form is often secondary to gonorrhœa, chancroids, syphilitic lesions, or general troubles, such as diabetes. It is, however, not due to the direct action of specific germs of the venereal disease, the gonococcus, for example, but to the irritation incident to the contact with decomposing discharges and to infection with the ordinary staphylococci. (See page 184.)

In certain cases the erosions and superficial ulcerations start from the corona, exhibit circinate borders, and progressively involve the entire mucous membrane of the glans and foreskin, lasting for several weeks, and, so far as extension is concerned, resisting all treatment.

As a consequence of balanoposthitis there may develop: (1) lymphadenitis; (2) condylomata; (3) hypertrophy; (4) gangrene.

Lymphadenitis, at least the suppurative form of the affection, is rare.

Condylomata frequently develop during or after balanoposthitis.

Hypertrophy of the foreskin, in the sense of a greatly elongated, thickened, rigid prepuce, interfering with physiological activity, may result in consequence of organization of the inflammatory infiltration consequent on repeated attacks of acute or subacute inflammation. It is noticed in middle-aged men, especially diabetics, and is usually accompanied by chronic inflammatory lesions of the glans or prepuce. It is sometimes followed by epithelioma.

When the inflammation is hyperacute, inflammatory swelling may be followed by gangrene. This is scarcely possible except in phimotic cases. There is little danger to life in this process, which is self-correcting. There may be, however, ultimate cicatricial deformity.

Diagnosis.—The superficial, irregular or circinate erosions, together with the surrounding surface hyperæmia and the characteristic discharge, render diagnosis fairly easy when the foreskin can be retracted.

Herpes will at first exhibit vesicles, and, when these vesicles have ruptured, circinate lesions. The distinction between these and the erosions of balanoposthitis is, however, not always possible, nor is it important.

Chancroidal balanoposthitis develops insidiously, is characterized by an inflammatory infiltration or thickening or hardening of the glans and foreskin rather than by an acute œdema, exhibits more distinctly circumscribed erosions, which are shortly converted into true ulcers, and is soon followed by characteristic inguinal adenopathy.

Syphilitic balanoposthitis, occurring as a secondary lesion, would be diagnosed by the history of the case, the appearance of characteristic lesions on other surfaces of the body, and the development of moist papules primarily, after which neglect of treatment might occasion a general inflammation of the preputial sac.

Only in cases of purulent discharge complicated by tight phimosis would there be difficulty in deciding between balanoposthitis, chancre, chancroid, and gonorrhœa. Gonococci would prove that gonorrhœa was present, auto-inoculation of discharge would show the presence of chancroid (although this is not to be recommended as routine practice), and a distinctly indurated area felt beneath the prepuce would suggest chancre. If, however, the prepuce were reddened, swollen, and painful, whatever the primary lesion, these symptons would almost certainly denote the development of balanoposthitis, and would call for the treatment appropriate to this form of inflammation.

Treatment.—The basis of all treatment is cleanliness. If the prepuce can be retracted, the inflamed mucous surfaces are washed with a mild antiseptic solution, dilute subacetate of lead lotion, or bichloride solution 1 to 4000, dried by means of absorbent cotton, and the erosions brushed with a ten per cent. silver nitrate solution; the parts are then dusted with a powder made of equal parts of bismuth subnitrate and calomel, a very thin layer of absorbent cotton is placed over the glans, and the foreskin is drawn forward. This dressing should be changed several times daily.

When the discharge is profuse, very finely powdered alum or tannin may be used in place of the calomel and bismuth. Lumpy or gritty dusting powders do more harm than good.

When the inflammation is unusually acute in type and erosions are extensive, a wet dressing is indicated. Under such circumstances, after washing, the dusting powder and silver nitrate are omitted, the thin layer of dry cotton being placed directly on the glans and then wet with the required solution, preferably dilute lead water, or fluid extract of hydrastis canadensis 1 part, rose water 9 parts. In phimotic cases the preputial sac should be washed out every two hours, first with warm water and soap, then with clear water, and then with mild antiseptic solutions, such as sublimate 1 to 4000, or carbolic acid 1 to 500, or, better still, a solution containing both these antiseptics in the proportion just given. This washing is best accomplished by means of a hard rubber syringe provided with a conical nozzle, though when the preputial orifice is sufficiently large a flat nozzle will occasion less irritation. The whole preputial sac should be ballooned out with the solution, unless great pain is caused by this distention. Following the antiseptic injection the hydrastis solution 1 to 10 should be used. When suppuration is very profuse, peroxide of hydrogen may precede the antiseptic injection.

General swelling of the prepuce is combated by keeping the parts wrapped in lint wet in dilute alcohol and lead water equal parts.

When gangrene threatens, an attempt to abort may be made by continued hot local baths,—*i.e.*, soaking the penis in dilute antiseptic solution as hot as can be borne for two hours at a time, two or three times a day. If this does not promptly relieve tension, the prepuce should be split along its dorsum, exposing the inflammatory lesions and allowing them to be treated directly.

Chancroidal balanoposthitis, or that complicating diabetes, is alone liable to occasion such marked swelling as to require splitting of the foreskin. Under these circumstances, the immediate completion of the operation by circumcision involves more risk than usual, but may be attempted after the patient has been fully warned as to the danger of infection of the wound. Good results may be obtained by following the procedure described under Chancroid. (See page 53.) In diabetic cases, in this region as elsewhere, rigid antisepsis is of especial importance.

Herpes Progenitalis.—This affection is characterized by the rather sudden appearance of vesicles clustering upon erythematous bases situated on the mucous or skin surfaces of the penis, and attended with itching and burning. (Fig. 17.) Commonly they appear in or about the coronary sulcus, involving both the glans and the foreskin. When thus placed the covering of these vesicles is quickly macerated, leaving rounded or irregular erosions which may become confluent but still exhibit a polycyclic outline. A mild balanoposthitis usually complicates herpes, and the affection sometimes causes suppurating buboes. Warts frequently develop.

When these lesions are neglected the abrasions may be converted into punched-out ulcers (ulcerating herpes).

Sometimes the lesions are accompanied by intense pain, much like that of herpes zoster; the affection is then termed neuralgic herpes. The pain may precede the development of the vesicles, which may be so few and discrete as to attract little attention. Exceptionally there is marked sexual erethism, causing prolonged erections and nocturnal pollutions. The burning shooting pain is generally confined to the penis; occasionally it is reflected to the perineum and the groins, and even down the thighs. This neuralgic herpes is sometimes accompanied by urethral discharge simulating gonorrhœa, but differing from it in the absence of gonococci. This discharge is not favorably influenced by local or general treatment. Herpes having once appeared is prone to develop again; at times the recurrence is observed hard upon the first attack, new crops of vesicles forming as fast as earlier lesions are healed. More frequently there is a distinct interval between attacks. When it has this tendency to relapse it is called recurrent, and is often neuralgic in type. Herpes appearing upon the skin surface of the prepuce does not differ from the eruption as observed on other surfaces of the body. The eruption, wherever it is situated, may be discrete, even to the extent of the formation of but one or two vesicles, or confluent, forming in this case usually small patches, sometimes completely covering large surfaces and causing intensely painful inflammatory erosions. The pain is so severe that the system suffers, and the patients, generally women, are confined to bed.

Etiology.—The causes of herpes are practically the same as those of balanoposthitis. The eruption is predisposed to by rheumatism, gout, and a neurotic tendency; also locally by any causes tending to excite inflammation, such as phimosis and urethral or preputial discharges. The mechanical irritation of immoderate coitus, together with the effect of prolonged contact with any irritating uterine or vaginal discharge, may be an exciting cause.

The *diagnosis* of herpes is founded upon the rather sudden appearance of vesicles in clusters, either without obvious cause or following closely upon mechanical or chemical irritation. When the lesions are observed in their vesicular stage they cannot well be confounded with any other affection. Thus, when they appear on the skin of the penis or scrotum there can be no doubt as to their nature. When they are placed on the mucous surfaces of the glans and foreskin, however,—and this is their usual situation,—they are rarely observed before the coverings of the vesicles have been macerated and the lesions are erosive or ulcerative in type. Even then they are usually superficial, multiple, circular, or, when confluent, at least circinate in type, non-indurated, except when placed at or within the urethral orifice, rapid in development, non-progressive, with moist, red surface, when squeezed give a slight serous discharge, and if kept clean rapidly heal, though new lesions may occur on previously healthy surfaces.

The differential diagnosis must be made from chancre, chancroid, balanoposthitis, and mucous patches. The points of difference between herpes, chancre, and chancroid are tabulated on page 834; though it is of sufficient importance to be repeated here that herpes sometimes (about once in ten cases) causes painless polyganglionic bilateral inguinal adenitis, exactly like that following chancre.

The lesions of balanoposthitis are usually more diffuse and rather irregular or serrated than polycyclic in outline. Moreover, they are not preceded by vesicles. The differential diagnosis cannot always be made, since herpes is generally accompanied by more or less balanoposthitis. Mucous patches are accompanied by other manifestations of syphilis, are slower in development than herpes, do not begin as vesicles, and present a grayish necrotic pseudo-membrane in place of the red, moist, shining surface of the herpetic lesion.

Treatment.—Cleanliness is the key-note of successful treatment. Antiseptic washings, careful drying, painting with silver nitrate, dusting with zinc oxide or bismuth, the interposition of a thin layer of cotton between the two mucous surfaces, and, if necessary, the remainder of the treatment described as appropriate to balanoposthitis, ordinarily bring about cure in a few days. When the inflammation is more than usually acute, a wet dressing should be substituted for the dusting powder. In the ulcerating form the system is usually at fault; here treatment appropriate to the general condition present should supplement local treatment, the gouty or tubercular diathesis receiving proper medication and diet.

Neuralgic herpes is often benefited by painting with silver nitrate solution ten grains to the ounce, or solution of chloral one drachm to the ounce, or carbolic acid lotion 1 to 60; the erosions should then be dressed as already described. This form of herpes is, however, not readily influenced by treatment. Local applications of cocaine will sometimes relieve the pain. This may be sprayed on, a four per cent solution being used, or the following ointment may be applied:

℞ Cocainæ hydrochlor., gr. xii;
Menthol, gr. i;
Lanolin, ʒiv.
M. S.—Use locally.

When the pain is harassing and unrelieved by local treatment, the galvanic current may be tried; this failing, the suffering should be relieved by an anodyne, since it will cease spontaneously in from four to twelve days.

Recurrent herpes is most frequently observed in connection with a redundant or phimotic prepuce or stricture. The cure of these conditions will often bring permanent relief. When there seems to be no local predisposing factor, the surfaces most often affected should be frequently bathed in aqueous solutions of hydrastis extract 1 to 5, or hot saturated solution of alum, and after exposure to any form of irritation should be thoroughly cleansed with mild antiseptic lotions, washed with the astringent, carefully dried, and dusted with stearate of zinc or bismuth, or carbolized talc. A general tonic and supporting dietetic and medicinal treatment should be prescribed at the same time, minute doses of arsenic and bichloride of mercury (grain one-sixtieth of each t. i. d.) and the less irritating iron preparations being particularly indicated.

CHANCROID.

The chancroid is a contagious venereal ulcer. It has no distinct period of incubation, is inflammatory and destructive in type, and is frequently accompanied by suppurating buboes. It is a local and not a constitutional disease. It has been variously named soft chancre, simple chancre, and non-infecting sore.

Cause.—Chancroid is due to the local action of micro-organisms. The pus is highly contagious, even when diluted; bactericides of moderate strength destroy its virulence.

It is generally accepted that chancroid is a *simple ulcer* caused by the inoculation of the well-known pyogenic microbes upon an abraded surface. It is held that this ulcer runs a somewhat peculiar course on account of the anatomical and physiological peculiarities of the tissues upon which it is usually situated. This belief is founded on the facts that the ordinary pyogenic microbes are always present in chancroidal discharge, and that these sores are most frequently encountered on the persons of those who are most exposed to infection by pyogenic microbes,—*i.e.*, those who are uncleanly. Moreover, inoculation with the pus of acne or of furuncle may produce sores presenting the characteristics of chancroids.

As opposed to these arguments and in favor of the dependence of chancroid upon a specific virus, the following points are worthy of consideration. In addition to the pyogenic micro-organisms found in every open wound, competent observers have described bacteria always associated with chancroidal lesions and appearing as pure cultures when repeated auto-inoculations are practised under antiseptic precautions. Chancroid nearly always arises from contact with the discharge from chancroid, and not as a result of the irritating action of retained or decomposing discharges from other sources. The chancroid nearly always runs a typical course, even in healthy persons, and involves the anatomically associated lymphatic glands in degenerative processes with far greater frequency than is observed in simple infections with pyogenic microbes. Auto-inoculation of the discharge of the fresh chancroid is nearly always successful, and can be repeated almost indefinitely. The inoculation ulcers after a second generation show no pyogenic micro-organisms, but only those which are held to be specific to the lesion. Auto-inoculation with pus from an ordinary ulcer usually fails, or, if successful, it produces a superficial lesion. A rapidly extending chancroid if thoroughly cauterized is at once converted into a simple ulcer, and, though pyogenic micro-organisms abound in the discharge of the latter, the lesion runs a benign and self-limited course, essentially different from that characteristic of chancroid.

Ducrey, Welander, and Krefting describe as the specific micro-organism of chancroid a short, thick bacillus, with rounded ends, much like a dumb-bell, about one and a half micromillimetres in length. The micro-organism is found in the protoplasm and between the cells, often in chains and groups. The staining solution is as follows:

Five per cent. boric solution, ℥ss;
Saturated aqueous solution of methyl-blue. ʒv;
Distilled water, ʒvi.

Cover-glass preparations made in the customary way are allowed to float in this dye for half an hour. They are then washed in distilled water, dried, and examined. The discharge from the chancroid may contain these micro-organisms, but compared with the number of other bacteria they are extremely few. In the first inoculation pustule these micro-organisms are more numerous, other bacteria becoming less in number. In the pustules of the third generation these bacteria appear as pure cultures. In no instance could an inoculation chancroid be produced without finding in the discharge the bacillus just described.

A review of the bacteriological evidence as to the microbic origin of chancroid leaves the subject still in doubt, since Jullien, Strauss, and others were not able to confirm the presence of a specific micro-organism, and since the proof afforded by the inoculation of pure cultures grown on artificial media is wanting. In our own practice repeated efforts on the part of competent bacteriologists to demonstrate the chancroid bacillus have been unavailing.

The clinical history of chancroid, however, marks it as a distinct and separate lesion.

Fournier states that where a chancroid is found there has been deposited chancroidal virus, and many other observers believe that chancroid is invariably due to inoculation of pus derived from a similar ulcer.

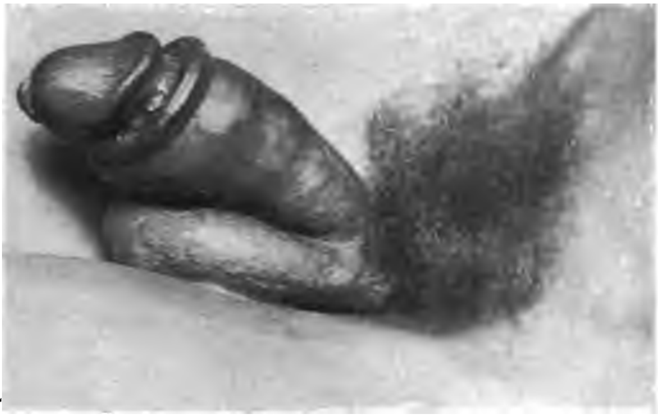
The Inoculability of Chancroid.—The chancroid is capable of almost indefinite reinoculation, the different parts of the body showing varying susceptibility to the action of the virus. When inoculations are made upon the thigh, large, sloughing ulcers not infrequently result. The lesions are more manageable when the belly is inoculated; while if the face, chest, or arms are selected they are still less serious. After a certain time the skin of the region in which many inoculations have been made acquires immunity against the development of further sores. This immunity is, however, only temporary. Successive inoculations have a tendency to become milder, and recent experiments conducted under antiseptic precautions appear to show that the original pus of each chancroid can be auto-inoculated only a limited number of times.

In the early stage of the original sore, auto-inoculation almost invariably succeeds, producing a characteristic chancroidal lesion. As the original sore grows older the virulence of the pus diminishes, until finally it disappears entirely, inoculation then producing simply the slight superficial lesion characteristic of the irritation of ordinary pus.

According to Finger and others, acute diseases attended with high fever, such as pneumonia, pleurisy, and the exanthemata, during their course render the patient immune against the inoculation of chancroidal virus. This, however, is disputed.

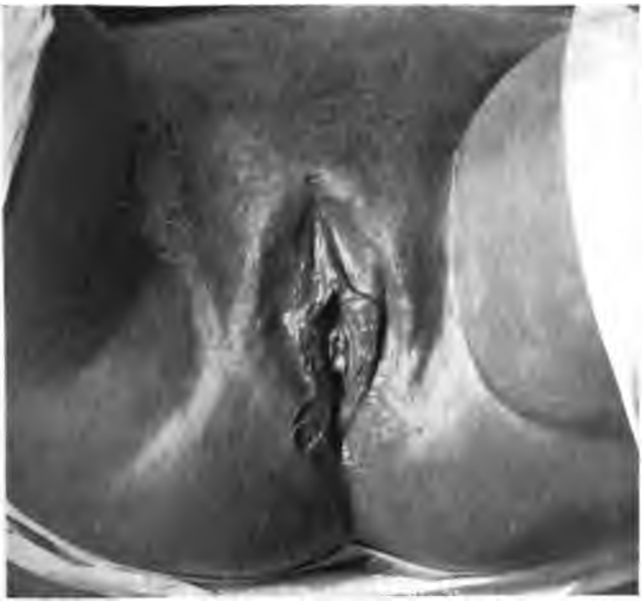
Frequency of Chancroids.—Chancroids are, in hospital practice at least (and especially in Europe), more frequently encountered than the chancre: hence given a patient with suspicious sores about the geni-

Fig. 18.



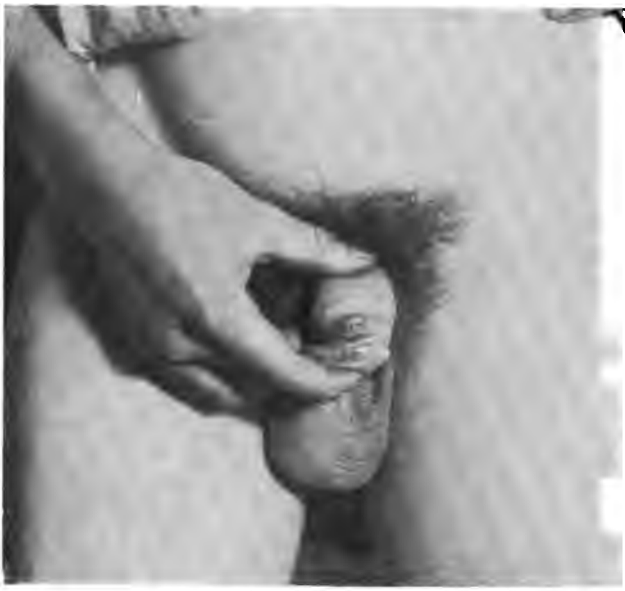
Multiple chancroids of the coronary sulcus.

Fig. 19.



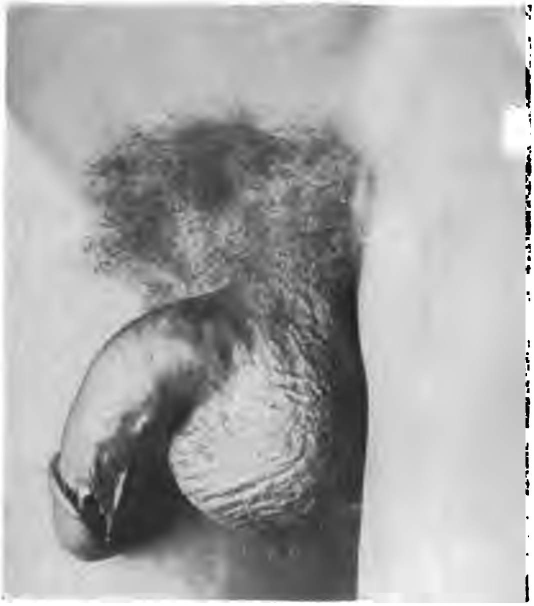
Chancroid of labium major.

FIG. 20.



Exulcerating or superficial chancroid

FIG. 21.



Follicular chancroid.

talia, the odds are in favor of such sores being chancroidal. Such a deduction cannot be drawn in private practice, however, since in all countries, among the well-to-do, the chancre is more frequently seen than is the soft sore.

Fournier states that the reason for this is that the hospital patients are poor, ignorant, and uncleanly, and hence careless as to the condition of the partners in their indulgences. The well-to-do are protected from chancroid by their cleanliness and general healthy condition, and by the fact that women suffering from a lesion as gross and as superficial in position as the non-infecting sore could probably not conceal the disease from them. Moreover, such lesions in the better class of prostitutes would be immediately subjected to treatment.

The Localization of the Chancroid.—The chancroid may be placed upon any cutaneous or exposed mucous surface. It is usually located on or about the genitalia. Reported cases show that it has attacked the mucous membrane of the mouth and nose, the conjunctiva, the scalp, and the fingers; but extragenital chancroid is far less frequent than extragenital chancre.

Genital chancroids in the male are usually found upon the glans and the prepuce. The favorite position is at or near the frænum, in the coronary sulcus (Fig. 18), along the margin of the prepuce, on the mucous surfaces of the glans and the foreskin, and at the urethral orifice.

In females these lesions are found along the margins of the greater and smaller labia, about the fourchette, and in the region of the urinary meatus. (Fig. 19.)

Anal chancroid is much more frequent in women than in men. In them it is commonly due to infection of cracks or fissures about the rectal opening by the contagious discharge which flows backward from the vulva. The chancroid is usually multiple.

The extragenital chancroids, if perigenital lesions be excepted, are rare. The history of inoculation proves that such lesions are possible, but as a matter of clinical experience they are not often encountered. This may be because they are often not recognized.

Pathology of Chancroid.—The chancroidal ulcer is made up of a small round-celled infiltrate, somewhat sharply limited in depth, but extending considerably beyond the borders of the ulcer, and invading papillæ which are still covered with apparently healthy epithelium. These papillæ undergo marked hypertrophy.

The blood-vessels are dilated and increased in number, and exhibit in the adventitia an inflammatory infiltration. The lymphatic vessels are also abnormally numerous, and open directly into the ulcer. If one of these vessels is injected at a point remote from the chancroid, this injection will flow from the surface of the sore. (Letzel.)

The Clinical Aspects of Chancroid.—The inoculation chancroid presents the lesion in its typical form.

Inoculation is practised by moistening the point of a scalpel in chancroidal discharge, then passing this point perpendicularly down to the true skin, rotating the knife on its long axis, and rubbing in as much of the discharge as remains on the sides of the blade. A watch-crystal placed over the point of inoculation and held in place by straps allows of inspection of the sore in all the phases of its development.

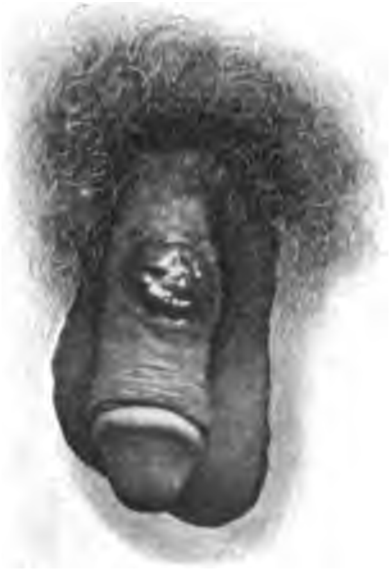
In from one to four days an inflamed pustule develops, which, on rupture, exposes a deep, rounded, ragged, punched-out, often undermined ulcer, with a gray, sloughing surface. This ulcer extends for a period varying from one to three weeks, then remains stationary for a few days, and finally undergoes resolution, ultimately healing and leaving a cicatrix.

Chancroid as acquired by coitus differs somewhat in its clinical aspects from that caused by intentional inoculation. The pustular stage is rarely observed, the patient not detecting the lesion until an ulcer has developed, since the chancroid is usually so placed that the thin skin covering the pustule is quickly macerated. The acquired chancroid frequently seems to have a period of incubation varying from three to seven days; exceptionally the apparent incubation is much longer; generally this is because the sore is not noticed in its early stages. Indeed, it is not uncommon in stripping back the foreskin to expose an ulcer which is at least several days old and of the existence of which the patient was entirely ignorant. Ricord explains these cases by the theory that the virus is deposited on healthy surfaces, which subsequently becoming eroded offer an entrance-point to the micro-organisms.

The shape of the chancroid will depend upon the shape of the eroded surface through which inoculation takes place, and also upon the anatomical peculiarities of the part. Thus, inoculation of a "hair-cut" will be followed by a linear chancroid; the inoculation of an extensive abrasion by a sore corresponding in outlines with this abraded surface. The lesions of herpes will preserve their general outline, but will take on chancroidal ulceration. An infected follicle will form first a hard, rounded, elevated lesion resembling a furuncle. This rapidly breaks down and discharges, exposing a characteristic chancroidal ulcer. When the chancroid involves the sides of the frænum it forms a long, irregularly shaped lesion, which not infrequently causes complete destruction of this bridle. When it is placed in the coronary sulcus it has a tendency to extend in the direction of this furrow. When it attacks the anus it spreads in the direction of the skin-folds of this region.

For convenience of description chancroids are frequently named in accordance with their clinical features. Thus, the *ecthymatous chancroid* is one characterized by the formation of thick crusts; the *exulcerating chancroid* is one which remains superficial (Fig. 20); the *follicular chancroid* is one which primarily involves a follicle, resembling first a furuncle, later producing a deep, often indurated lesion (Fig. 21); the *ulcus elevatum* is one which is raised from the surrounding tissues, owing to a more than usually abundant inflammatory infiltrate, which, moreover, may so closely simulate the hardness of a syphilitic sore as to make diagnosis a matter of great difficulty. (Fig. 22.) If from lessened tissue-resistance to virulent infection there is excited inflammation more acute than is commonly observed, there results an *inflamed chancroid.* If this inflammation occasions rapid extension of the lesions, together with sloughing of surrounding tissues, the chancroid is termed *phagedenic.* (Fig. 24.) Where this tissue-destruction is both rapid and extensive, the lesion is termed *gangrenous.* When the chancroid becomes chronic, spreading slowly and reaching enormous dimensions, often healing in one part while it is extending in another, it is termed *serpiginous.*

FIG. 22.



Indurated elevated chancroid.

Symptoms.—(1) There is no period of incubation; (2) the lesions are multiple; (3) they begin as pustules or ulcers and are rapid in their course; (4) they form ragged, punched-out, often undermined ulcers, irregular in shape, discharging freely, inflammatory in type, and covered with a gray, pus-soaked slough, which may be concealed by a thick, moist scab (Fig. 23); (5) they produce similar lesions on surfaces with which they come in contact, and their discharge can be inoculated on any portion of the surface of the body; (6) they are not indurated; (7) scrapings from their surfaces show pus and shreds of necrotic tissue, but no epithelium; (8) they are frequently complicated by inflammatory bubo.

A positive diagnosis cannot be founded on any one of these characteristic features of the sore, but must rather be based upon associated symptoms. Thus, as a rule, there is no period of incubation, yet there are many reported cases in which such a period apparently existed. While the lesions are often multiple, this is by no means an invariable rule. The characteristic feature in regard to the multiplicity of chancroids is that they generally appear not simultaneously, but *successively*—*i. e.*, from auto-inoculation; though when several abrasions are inoculated at the same time the multiple lesions will, of course, develop coincidently.

Though the disease usually begins as a pustule or an ulcer, its first manifestation may take the form of a more or less indurated papule, in which acute inflammatory phenomena may progress with comparative slowness. The follicular chancroid sometimes develops in this way. Exceptionally the chancroid appears as a purely superficial lesion, the nature of the sore in this case not being suspected until it either suddenly assumes typical chancroidal characteristics or by auto-inoculation proves its true nature.

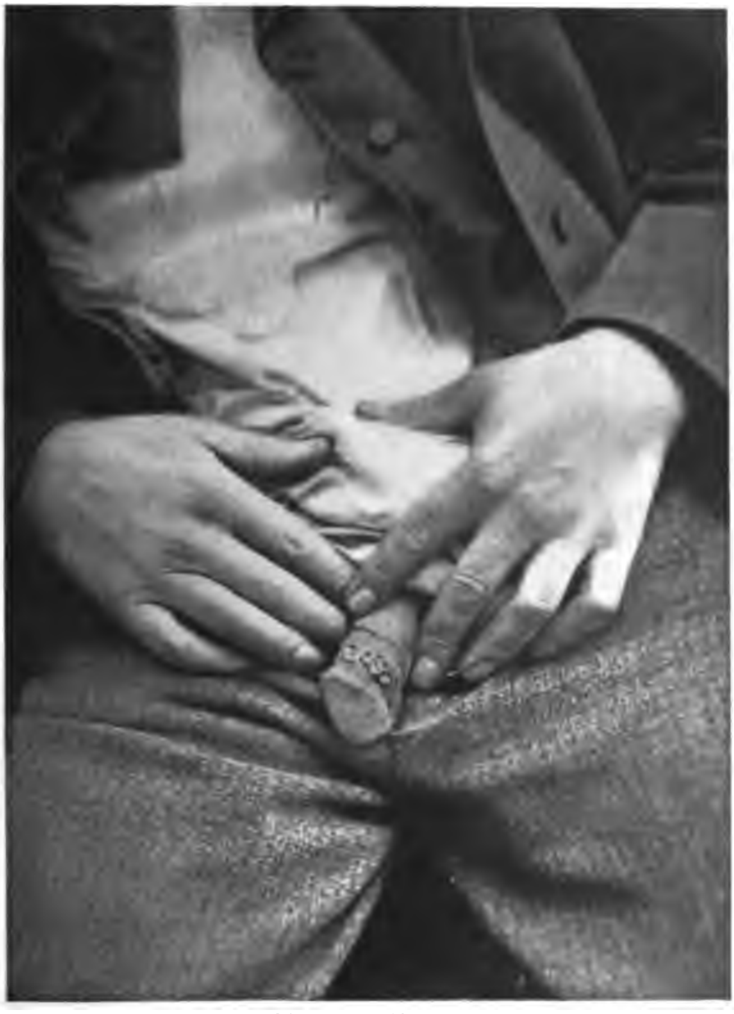
Auto-inoculation, if practised after the virulent stage of the chancroid is passed, will not succeed, and the discharge of other sores exceptionally produces by inoculation lesions not unlike those caused by chancroidal pus.

Sometimes chancroids are indurated; this is particularly true of the follicular chancroid and of those sores which have been cauterized. Finally, suppurating buboes, when the chancroids are seen early and are carefully treated, are the exception rather than the rule.

Hence in determining the nature of such a sore the general symptom group will be taken rather than any one peculiarity, and upon this an opinion will be given, always modified by the knowledge that, even though the lesion be distinctly chancroidal in type, it is possible for it ultimately to develop into a typical chancre.

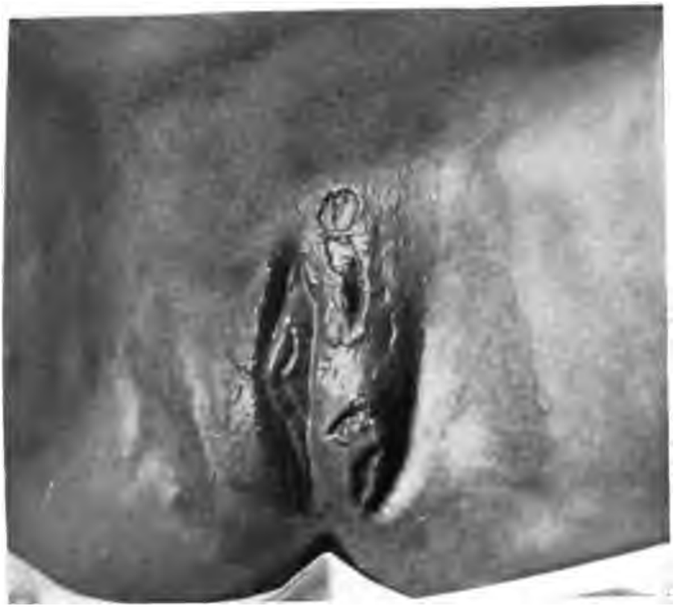
What might be called the natural auto-inoculation—that is, the production of other and similar sores upon healthy surfaces with which the first lesion comes in contact—is one of the strongest reasons for pronouncing an ulcer chancroidal in nature, since this, though possible, rarely takes place from other forms of ulceration.

Fig. 23.



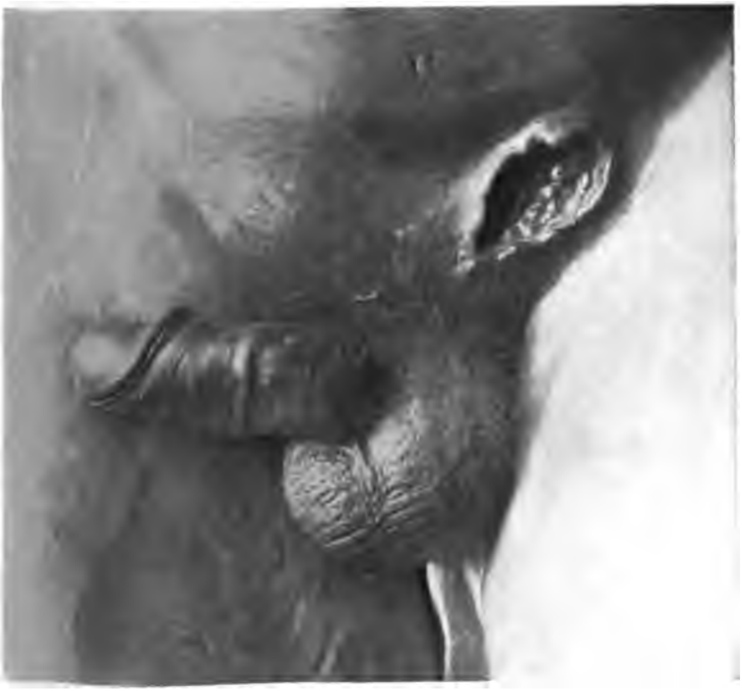
Multiple chancroids. (Fox.)

FIG. 24.



Phagedenic chancroid

FIG. 25.



Chancroidal bubo.

Diagnosis—Chancroid must be distinguished from *chancre*, from *herpes*, from *follicular abscess*, from *erosions of balanitis* and *balanoposthitis*, from *ulcerating papular syphilides*, from *ulcerating gummata*, and from *tuberculous ulcerations.*

The distinction between the soft sore and the *chancre* is one which the surgeon most frequently will be called upon to make, and is sometimes extremely difficult; it may, indeed, be quite impossible to formulate it. The typical features of each sore, with a diagnostic table, have been set forth in another part of this work (see section on the primary sore of syphilis), but it is not amiss to call attention here to the fact that the chancroid may be indurated whilst the chancre may not be. In the chronic chancroid attacking the vulva of women, the secondary hardening may be so absolutely like that of the primary lesion of syphilis as to deceive the most skilled. Again, chancroid may cause chronic enlargement of several of the inguinal lymphatic glands, thus departing from its type, while chancre may make a parallel variation by causing suppurative lymphadenitis.

In typical cases a distinction may be readily made, but in those which are atypical the surgeon should not commit himself to a positive opinion, since even so skilled a syphilographer as Fournier acknowledges that he has been deceived.

The mixed chancre—that is, the lesion resulting from inoculation with chancroidal virus and the virus of syphilis at the same point—can be properly diagnosed only after prolonged observation: hence, even though the sore conform absolutely to the chancroidal type, it is not safe to assert on first inspection that syphilitic infection has not taken place.

The lesions of *herpes*, *follicular abscess*, the erosions of *balanitis* and *balanoposthitis*, or *mechanical abrasions* may readily be mistaken for chancroids when they first appear. In a few days, at most, the superficial nature of the inflammation and the prompt yielding to cleansing applications show that chancroidal infection is absent.

Ulcerating papular syphilides when found upon the genitalia closely resemble chancroids, but are more slow in their course, are less inflammatory in type, and exhibit other lesions of the disease; on examination of the patient a history of preceding syphilitic infection usually may be elicited.

Ulcerating gummata of the genitalia produce lesions indistinguishable in appearance from chancroids. Here, again, however, a history of syphilis, the development of a tumor preceding ulceration, the slow progress of the lesion, the absence of the symptoms of acute inflammation, and the effect of constitutional treatment will lead to a correct diagnosis.

Tuberculous ulcers are extremely rare; they cannot be distinguished from chancroidal lesions by inspection alone. They have, however, a history of very slow extension, are usually associated with tuberculous lesions in other parts of the body, sometimes exhibit about the periphery of the ulceration grayish, semi-transparent, miliary tubercles, and on microscopic examination of the scrapings of the lesion often show the tubercle bacillus. Moreover, inoculation on guinea-pigs will after a time disclose the true nature of the lesion.

Sometimes a differential diagnosis can be made only by auto-inoculation,—a valuable means of determining the presence or absence of the chancroidal virus, but one which is not infallible. Its value is perhaps best formulated by stating that the majority of chancroids will produce ulcers of a similar type on inoculation, while the majority of other ulcers, either syphilitic, tuberculous, or inflammatory, will not produce such lesions.

COMPLICATIONS OF CHANCROID.

1. Phimosis and paraphimosis; 2, Excessive inflammation, phagedæna, and gangrene; 3, Lymphangitis and lymphadenitis.

Of all these complications lymphadenitis, or bubo, is by far the most common.

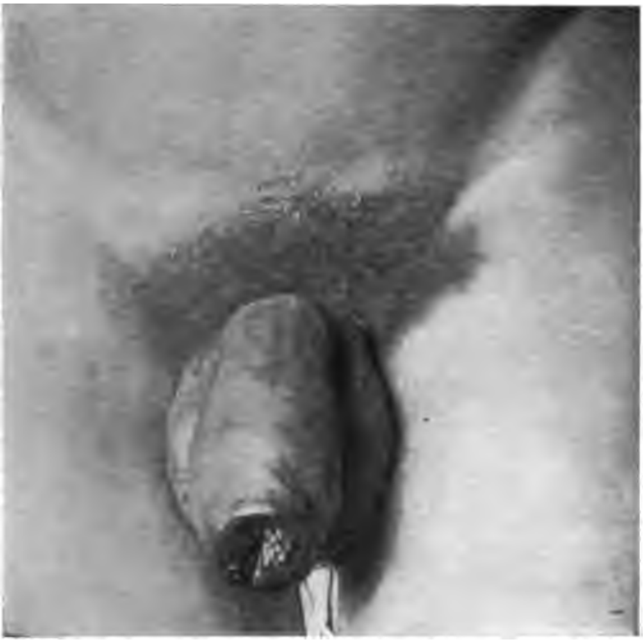
Phimosis.—This forms a serious complication of chancroid, mainly because it prevents the ulcer from being efficiently treated and causes retention of discharge, and consequently favors the occurrence of acute inflammation and the formation of inguinal buboes.

Sometimes a chancroid develops upon the glans penis or the inner preputial surface in cases congenitally phimotic. More frequently phimosis is occasioned by the swelling incident to the lesion,—a long, easily retracted foreskin becoming from œdema and infiltration so thickened and the preputial orifice so narrow that retraction is impossible. If the chancroid is placed upon the outer surface of the prepuce this complication is of slight moment, usually yielding quickly to treatment. When, however, the sore is concealed and rendered inaccessible by the swelling, a vicious circle is established, which may be productive of the most serious consequences. The irritation incident to retained and decomposing discharges increases the inflammatory swelling, renders the phimosis still more complete, and by interfering with circulation weakens tissue-resistance, so that the lesion rapidly extends, a ring of inoculation chancroids often developing about the preputial orifice. (Fig. 26.) In severe cases extensive sloughing and gangrene occur. The foreskin becomes dark, almost black, cold, non-resisting, and finally melts down at one or more points into a putrid, pultaceous mass. This gangrenous process may attack also the glans penis, and partly or totally destroy it.

Diagnosis.—The diagnosis of subpreputial chancroid is founded upon the severity of the inflammatory symptoms, upon their persistence, or even their aggravation, in spite of careful treatment, and upon the result of auto-inoculation. At times palpation will elicit local tenderness, and the inflammatory induration of the lesion may be recognized by touch through the foreskin.

Herpes and balanoposthitis rarely occasion as active local symptoms as does chancroid. The discharge is moderate; the œdema is not excessive; cleansing treatment quickly cures.

FIG. 26.



Chancroidal phimosis. Secondary chancroids about the preputial orifice.

Concealed chancre occasions moderate swelling, can be felt as an indurated plaque or nodule, and is accompanied by the inguinal adenitis and other symptoms of chancre.

Gonorrhœal phimosis, usually associated with balanoposthitis, will show in the discharge the gonococci, and will be accompanied by ardor urinæ, felt along the urethra, by chordee, and by the other symptoms of gonorrhœa. It must not be forgotten that both gonorrhœa and chancroid may be present.

Treatment.—In the case of chancroid complicated by phimosis requiring circumcision, ether should be given, the parts should be repeatedly disinfected, but not by the operator or his assistant, nor should any of the basins or solutions be used which are subsequently to be employed during the operation; the foreskin should then be split to an extent just sufficient to allow of thorough cauterization with the Paquelin cautery of all the chancroids and of the wound made in splitting. All the towels surrounding the penis, and the solutions and basins used in former washings are removed. The seat of operation is surrounded with a fresh sterile or wet bichloride towel, the glans and foreskin are put through a vigorous course of cleansing with fresh solutions from a clean set of basins by the surgeon and his assistants, and the circumcision is performed. The coaptation should be exact. A wet dressing is applied, preferably the gauze bandage wrung out of dilute lead water and alcohol equal parts, and the patient is kept in bed for five days, with the penis and scrotum supported by a pillow of antiseptic cotton covered with gauze. Often, in spite of every precaution, the entire circumcision wound becomes chancroidal. When redness, swelling, and suppuration at one or more points foretell this, the stitches must be taken out, and the wound dressed several times daily, as described under chancroid.

Paraphimosis.—Patients with congenitally short prepuces, or those whose foreskins are habitually retracted, frequently suffer from paraphimosis incident to the swelling occasioned by chancroid; or this condition may result from retraction of the foreskin after the swelling is well advanced, as it is then often impossible to draw it forward. This complication is much less troublesome than phimosis, since the lesion is exposed and can be properly treated. It occasions, however, more rapid and dangerous congestion than phimosis, and usually demands immediate relief.

Gangrene—Phagedæna.—Chancroids may be unusually inflammatory in type from the first, or after a comparatively mild course may suddenly become acutely inflamed.

The causes of this are usually a *general cachectic condition*, *local irritation*, either mechanical, as from coitus, or chemical, as from filth, decomposing discharges, and irritating applications, and *disturbances of circulation*, as from phimosis and paraphimosis.

In these cases swelling and redness extend far beyond the lesion and the whole involved part becomes œdematous. The patient complains of pain, there is often a mild inflammatory fever, and the ulcer rapidly spreads.

If the causes producing inflammation remain still operative and prompt treatment is not applied, the lesion becomes *gangrenous*; in this case swelling is more pronounced, and large areas become dusky red, dirty brown, and finally quite black and putrid. In a very few hours extensive tissue-destruction may result. The entire penis may be destroyed, the testicles may be laid bare, and the process may extend far up the belly-walls. The constitutional symptoms are pronounced.

At times the destructive process is much slower in its course, ultimately producing lesions quite as extensive, but rather by molecular death. The ulcer steadily extends, in spite of treatment, until it attains enormous dimensions, exposing the blood-vessels of the groins, destroying the entire scrotum, eating far back along the perineum, and leaving but the stump of the penis. This process is termed *phagedenic*, and is never observed except in those whose systems are profoundly depressed. Thus it is encountered in diabetics, or in those suffering from scurvy or scrofula, from visceral diseases, such as chronic hepatitis and nephritis, or from tertiary syphilis.

The phagedenic ulcer sometimes lasts for months or years, manifesting a tendency to heal in one part whilst it steadily extends in another, the lines of extension often having a circinate or serpentine outline. This form of ulceration is termed *serpiginous*.

Lymphangitis, or inflammation of the lymphatic vessels, is a rare complication of chancroid; even though suppurating buboes develop, the lymphatic vessels which carry the irritating substance from the ulcers to the glands are generally spared. When they are involved there is formed, usually on the dorsum of the penis, a tender, indurated cord, over which the skin is reddened. The perivascular tissues become infiltrated and œdematous, and there may be considerable swelling of the subcutaneous tissues. Resolution usually takes place under appropriate treatment. Exceptionally suppuration occurs. At one or more points the swelling is more marked, the skin is adherent and bluish red, fluctuation is detected, and an abscess forms. This opening usually heals kindly; but sometimes it is converted into a chancroid.

Bubo, or lymphadenitis, as has been stated, is the commonest complication of chancroid. The number of cases suffering from this complication varies, according to different reports, from five per cent. to thirty per cent. of the total number suffering from chancroid. In hospital practice about one out of five ambulant chancroid cases develop bubo; in office practice and among the well-to-do this complication is comparatively rare. This is because intelligent people detect the sore early and have it treated. The glands involved are generally those to which the lymph-vessels supplying the seat of ulceration pass most directly,—*i.e.*, the group of glands lying below Poupart's ligament, above the saphenous opening. The glands lying near the middle line of the body to the right and left of the symphysis pubis generally escape. Adenitis from lesions of the foot or leg attacks primarily the glands lying just below the saphenous opening in the course of the long saphenous vein.

It is usual, in cases of sores on the genitalia, for bubo to form on the side of the body corresponding with that of the lesion. This rule is at times reversed, sores on the right side of the penis, for instance causing suppurating bubo in the left groin. Lesions of the frænum frequently cause double buboes,—that is, involvement of lymphatics in both groins,—and, indeed, sores of this region and upon the prepuce and glans are followed by a larger percentage of buboes than when the chancroids are located on any other part of the genitalia.

In patients of a tubercular tendency frequently the entire lymphatic chain of glands slowly enlarges, forming a lobulated tumor, sometimes the size of a man's fist. Softening and disintegration take place slowly, and if the case is untreated fistulæ will form, which may last for months or years.

The bubo is generally single and unilateral; it may be multiple and bilateral.

Cause.—Aside from the fact that retained discharges distinctly predispose to bubo, the character of the sore seems to have little influence in the development of this complication. Thus a sloughing or gangrenous chancroid will run its course without any effect upon the lymphatic glands, while a superficial lesion the size of a split pea may be accompanied by a double suppurating lymphadenitis.

This complication usually develops from the second to the fourth week of the chancroid. It may, however, appear almost as soon as the lesion, or may develop weeks after the chancroid has been completely cicatrized.

The *direct cause* of bubo is not clearly formulated. It has not been demonstrated that the destructive adenitis is invariably due to the action of micro-organisms upon the gland. Cultures and auto-inoculations made with the discharge of buboes give negative results, and microscopic examination of such discharge may fail to show bacteria. The degeneration of the glands is probably owing partly to the presence of a chemical irritant absorbed from the ulcerating surface.

Symptoms.—The bubo usually begins with a sense of pain on motion referred to the inguinal region. On examination there is found a hard, tender lump over which the skin is freely movable.

This lump steadily increases in size, becomes constantly painful, and is so tender that the patient is confined to his chair or bed. The overlying skin becomes reddened, adherent, and œdematous. The patient complains of rigors, fever, and thirst, and finally on examination fluctuation is detected.

The pain may be constant and almost unbearable; sometimes without obvious cause it is suddenly relieved. This is due to rupture of the gland capsule and escape of its contents into the surrounding tissue, and is followed by rapid increase of swelling and breaking down of the periglandular tissues.

On evacuation of the suppurating bubo, thick, blood-stained pus is discharged, leaving a cavity with gray and necrotic walls. On digital examination of this cavity it is often possible to detect several swollen glands which have been involved in the inflammatory process but have not yet been completely destroyed. These are felt projecting into the space from which the pus has been evacuated.

If the abscess is untreated, the pus often burrows in various directions, forming long sinuses before spontaneous evacuation takes place. These seriously complicate the subsequent course of the affection.

Usually, after evacuation of the pus and proper surgical treatment of the resulting cavity, healing takes place promptly. In such cases the lesion is said to be a *simple bubo.* Exceptionally soon after opening the bubo its whole surface becomes converted into a huge ulcer corresponding in type with chancroid. This is termed the *chancroidal bubo.* (Fig. 25.) Appropriate treatment, however, shortly converts this into a simple ulcer, which ultimately heals kindly, though, as in the case of the chancroid itself, inflammation, gangrene, or phagedæna may complicate the healing. It is probable that the bubo is never primarily chancroidal, but becomes so by inoculation either during or after operation.

In women buboes rarely complicate chancroids. When they occur they are generally found in the inguinal region, the lymphatic vessels about the vulva and the rectum communicating with the glands of the groin.

Prognosis.—The chancroid as it occurs in healthy people, and especially in those who are cleanly in their habits and who will scrupulously follow a mild antiseptic treatment, runs its course in from three to six weeks without complication. Even if no treatment whatever is applied, the majority of chancroids will heal spontaneously in six weeks. During the whole course of the lesion, and even after cicatrization has taken place, buboes may form, and prognosis as to the avoidance of this complication should be extremely guarded. Except in the most superficial forms, the lesion is followed by scarring.

TREATMENT OF CHANCROID.

Since it is pretty generally conceded that chancroid is due to inoculation with the discharge of a similar lesion, and since such inoculation takes place almost invariably by sexual congress, the prophylaxis of chancroid is comparatively simple. Where, however, this means—*i.e.*, avoidance of exposure—is not adopted, careful and thorough washing with weak antiseptics, particular attention being devoted to the folds of skin in the region of the frænum, and the treatment of abrasions by means of strong solutions of mercury bichloride or of carbolic acid, 1 to 200 of the former, 1 to 10 of the latter, will nearly always prevent the appearance of chancroid. These solutions should be applied directly to the abrasions by means of a small cotton swab, and should not be employed as lotions for the entire penis.

Whatever form of treatment is adopted, the end to be attained is the conversion of the unhealthy spreading ulcer into a healing, granulating surface. Since the virulent properties of the chancroid are dependent upon the presence of micro-organisms, it necessarily follows that efficient treatment must have for its end either an inhibitory or a destructive action upon these micro-organisms, or must so increase the local resistance that the lesion cannot spread. Antiseptics in some form are indicated. These should be either so mild that they produce little or no irritation, or so powerful that they cause total destruction of the entire diseased area,—*i.e.*, they should be distinctly cauterant.

Under the application of mild antiseptics the chancroid is usually cured in from two to six weeks. Under the application of cauterants a cure sometimes results in from seven to fourteen days.

Satisfactory results may be obtained by the observance of surgical cleanliness, not only of the surface of the sore, but also of the surrounding skin or mucous membrane. After thorough washing with soap and hot water, a spray of hydrogen peroxide, full strength, is directed on the chancroid and the skin near it; this is followed by washing or spraying with carbolic 1 to 60 or bichloride 1 to 3000.

After the chancroid and the surrounding surfaces have been cleansed, the surgeon may conduct the treatment with either non-irritating antiseptic applications or with cauterants.

NON-IRRITATING ANTISEPTIC APPLICATIONS may be made in the form of powders, of ointments, or of lotions.

Dry Dressings.—The powders commonly employed are iodoform, aristol, iodol, boric acid, calomel, acetanilid, zinc stearate, zinc oxide, and bismuth subnitrate. None of these are strongly antiseptic. The most efficient is iodoform; this has practically no antiseptic value, but in the presence of pus undergoes decomposition, the products of which render ptomaines inert and have a distinct inhibitory effect upon further germ-growth. The objections to the use of the drug are its penetrating odor and occasionally the production of violent inflammation. The odor may be in part disguised by mixing with the powder, in the proportion of a drop to a drachm, oil of lavender or attar of roses, or finely pulverized coffee in the proportion of one part to five may be added to the iodoform. None of these expedients will be found perfectly satisfactory.

In applying this powder it is important to bring it directly in contact with the ulcerating surface; when it is placed upon the surrounding skin or upon crusts covering lesions it is absolutely useless, except to intensify the odor. It can be dusted upon the cleansed lesion by means of a small pledget of cotton which is first rubbed in the powder, or by an insufflator, or in the form of a spray of iodoform in ether. It should be used only after the lesion has been thoroughly cleansed by hydrogen peroxide and dilute antiseptics.

Iodol and aristol have similar properties, but are more prone to form crusts, thus favoring retention of discharge. In clinical practice they have been found distinctly less efficient than iodoform.

Zinc, calomel, and bismuth are mainly efficient as drying agents, though they undoubtedly have feeble astringent and antiseptic properties.

In the application of dusting-powders they should never be allowed to form with the secretions scabs or crusts, thus preventing the escape of discharges, and they should be brought immediately in contact with granulating surfaces. Boric acid and salicylic acid are sometimes useful as dusting powders, and are less prone than to form crusts than the insoluble preparations. Salicylic acid is often so irritating that its application is not advisable, especially as its antiseptic powers are limited.

STON MED
FEB 27 1907

If dry dressings are used, the lesion is treated from one to six times a day in accordance with the amount of discharge. It is first cleansed, then dried by means of absorbent cotton, then dusted with the remedy of choice; finally a thin sheet of absorbent cotton is laid over it, and is retained in position by straps or bandages, or by pulling the foreskin forward.

Dry dressing is indicated in chancroids of moderate severity which are not inflammatory in type and which do not discharge profusely.

Wet Dressings.—In place of the dusting powders, after thorough cleansing of the lesions and surrounding parts there may be placed on the ulcerating surface pledgets of cotton wet in one of a variety of mild antiseptic lotions. Of these the most efficient are carbolic acid 1 to 60, bichloride 1 to 3000, zinc sulphate 1 to 60, copper sulphate 1 to 60, phénol sodique 1 to 6, dilute lead water. These wet cotton pledgets should be changed frequently, especially when the discharge is abundant. This is readily managed, since the patient can carry with him a small bottle of the antiseptic solution and some cotton. He should change the cotton pledget each time he urinates. The dressing is kept in place by the foreskin in many cases, or by straps, bandages, jock-straps, or swimming-tights.

The wet dressing is especially indicated in patients whose inclination or surroundings prevent them from carrying out the careful cleansings required in dry dressings, and in patients whose lesions discharge freely and are inflammatory in type.

Antiseptic Ointments.—Ointments employed in the treatment of chancroid have for their active principle a drug such as iodoform, boric acid, salicylic acid, carbolic acid, or one of a large variety of similar antiseptics. They are most useful when there is a tendency to form crusts, and when the lesions are cicatrizing.

CAUTERIZATION.—Immediate and complete destruction of a chancroidal ulcer is the safest routine treatment, since thus its virulent qualities are immediately destroyed and there results a healthy granulating surface which quickly cicatrizes, and which, if kept clean, is attacked only in very exceptional circumstances by the complications characteristic of chancroid. The main objection urged against this method of treatment is that it is unnecessarily severe, since the majority of chancroids will heal kindly under simple antiseptic dressings. This argument obtains particularly among the well-to-do, who, by careful observance of treatment, usually recover promptly. In dispensary patients, however, and in those who are careless, or who, from their surroundings, cannot treat chancroids in accordance with the principles of surgical cleanliness, cauterization is particularly to be commended.

For cauterizing chancroids, nitric acid, sulphuric acid, caustic potash, bromine, iodine, zinc chloride, copper sulphate, arsenous acid, and the actual cautery have all been successfully employed.

The best instrument for destroying chancroids is the actual cautery; this may be used in the form of a heated iron, Paquelin's cautery, or the galvano-cautery.

In performing the operation the chancroid and the surrounding healthy area are first thoroughly cleansed, and are then anæsthetized by means of a spray of ten per cent. solution of cocaine directed against the ulcerating surface and by hypodermic injection of ten drops of a one per cent. solution of eucaine driven into the cellular tissue surrounding the base of the lesion. The cautery at a white heat is then applied, so that not only the chancroid is destroyed, but also the surrounding tissue to the extent of one-eighth of an inch from the borders of the sore. The cautery must be carried to every recess of the ulcer. If sinuses are present, these must be slit up and their unhealthy walls cauterized. If the minutest portion of the sore is left untouched by the cautery, the probability is that the entire lesion produced by the operation will again become infected. After cauterizing, the chancroid and the surrounding parts should again be thoroughly disinfected. The dry eschar resulting from the burning is dusted with iodoform and protected by the application of a little absorbent cotton. In from three to five days this eschar comes away, exposing a healthy ulcer, which quickly cicatrizes.

Inflammatory swelling resulting from this application is combated by the application of strips of lint wrung out of dilute lead water, or dilute lead water and alcohol equal parts, and kept constantly wet with this solution.

In case the actual cautery cannot be employed, nitric acid is generally used. This is applied by means either of a glass rod or of a pledget of cotton wrapped on a wooden applicator. It is thoroughly rubbed into the chancroid and carried a little wide of the ulcerating surface. The dressing in this case is the same as that applied after the use of the actual cautery.

Caustic potash, iodine, and other cauterants are employed in the same way.

Cauterization is indicated when chancroids are seen in their early stages, when they are rapidly extending, and when they are gangrenous, phagedenic, or serpiginous.

Cauterization is contra-indicated when the inflammatory swelling incident to its use would probably occasion phimosis and paraphimosis, when the chancroid is markedly inflamed but not yet sloughing extensively, and when the lesion has passed through its virulent stage and is healing.

Operation.—Two operations have been suggested and carried out in the hope of accomplishing the immediate cure of chancroid.

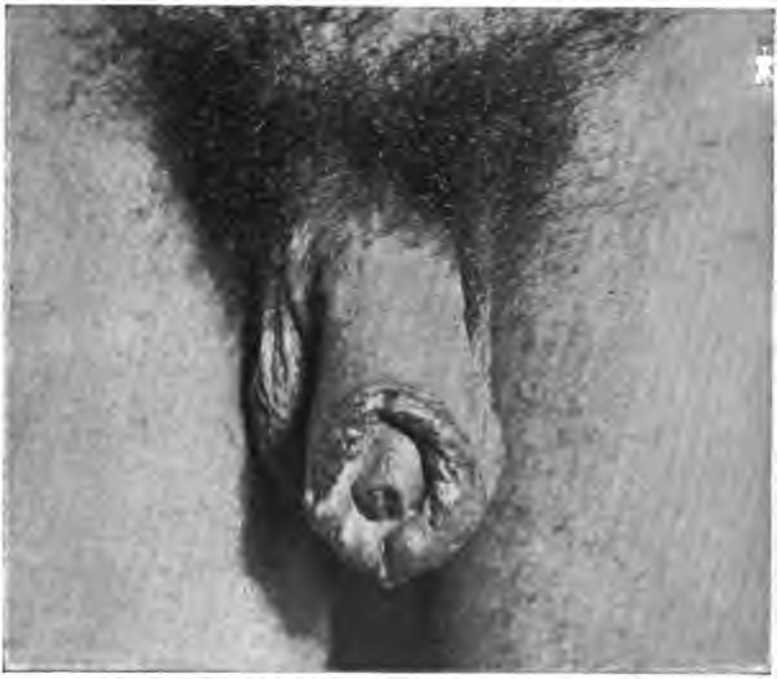
The first requires a thorough curetting of the lesion, careful antiseptic washing, and dusting with iodoform powder.

The second requires excision of the lesion and immediate suture of the resulting wound.

If reports of cases can be accepted as conclusive evidence in favor of any treatment, these operations should be universally adopted. Our experience, however, has not corroborated the favorable opinion of these methods advanced by others.

Treatment of the Complications of Chancroid.—PHIMOSIS.—When the subpreputial chancroid is complicated by phimosis, efficient treatment is rendered difficult by the fact that the sore is not readily accessible and by the retention of discharge; consequently such lesions are prone to become inflammatory in type, to excite œdema and congestion, to develop phagedenic or gangrenous symptoms, and to be complicated by buboes. When the symptoms of inflammation are moderately severe, satisfactory results may be obtained by the frequent employment of mild antiseptic subpreputial washes and the external application of evaporating lotions. Thus the whole preputial sac may be syringed out every two hours with hydrogen peroxide, followed by mild bichloride solution 1 to 6000, or

FIG. 27.



Chancroidal ulceration of an incision of the prepuce required for the relief of phimosis.

other unirritating antiseptic. The penis should be kept elevated, so that venous congestion may be diminished, and should be wrapped in lint kept wet with alcohol and lead water equal parts of each; or, when the circumstances of the patient are such as to permit this treatment, subpreputial washes, followed by prolonged soaking of the penis in water as hot as can be borne, are at times most efficacious in reducing inflammation. The soaking should last for an hour, and should be repeated three or four times daily.

If, despite this treatment, swelling rapidly increases, and it is evident that the chancroid is steadily extending, there should be no hesitation in splitting the prepuce along the dorsum, exposing the chancroid, cleansing it carefully, and thoroughly cauterizing it. The cautery iron should also be carried along the preputial incision, since otherwise this fresh wound would probably become infected and form a chancroid as virulent in type as that for the relief of which the operation was required. (Fig. 27.) The objection to performing circumcision at this time lies in the fact that the operation wound is usually converted into a chancroid. Moreover, when there is great œdema, there is difficulty in accurately gauging the flaps. These objections are not of sufficient weight to cause circumcision to be rejected invariably; indeed, in a fair proportion of cases, when every antiseptic precaution has been taken, union may be almost as prompt as when non-chancroidal lesions are subject to operation. There can, however, be no certainty that the circumcision wound will remain healthy.

Paraphimosis.—When paraphimosis complicates chancroid, an effort at reduction should be made immediately, unless the swelling is so great that there is obviously no chance of succeeding. If, as a result of the paraphimosis, there are not great congestion and œdema, and the chancroid is not obviously extending, it may be sufficient to treat this condition in accordance with ordinary principles, —elevating the penis and keeping it swathed in cloths wrapped in evaporating lotions. If, however, the œdema is rapidly growing more marked and the ulcer is extending, a cutting operation should be practised, the paraphimosis being reduced. Before doing this it is well to cauterize the chancroid thoroughly, and after the reduction to sear the operation wound. If there is danger of converting the case by reduction to one of inflammatory phimosis, the foreskin should be split along its dorsum, as advised for phimosis, and the line of incision cauterized. When the congestion incident to phimosis or paraphimosis reaches such a point that gangrene is threatened, operative interference is imperative. It is possible to treat these cases under cocaine anæsthesia, but, since both the use of the knife and the application of the cautery should be deliberate and thorough, and since the results of hurried or partial treatment are often disastrous, ether should be administered.

Gangrene and Phagedæna.—When gangrene develops, the first indications are to relieve constriction or pressure. When it complicates a phimosis or a paraphimosis, these conditions should receive prompt surgical treatment. The patient must be kept in bed, with the involved parts elevated and wrapped in hot antiseptic fomentations frequently changed. These may be made by wringing out pads formed of twenty or thirty layers of gauze wet in bichloride solution 1 to 4000 as hot as can be borne, enveloping the gangrenous regions in these pads, and covering this dressing with oiled silk to prevent evaporation. These compresses should be changed every fifteen minutes. Prolonged soaking of the parts in hot water or a hot mild antiseptic solution is a powerful means of arresting gangrene.

If, in spite of treatment by heat, the gangrene is rapidly extending, the parts already devitalized should be clipped away, and the ulcerated and raw surfaces should receive a thorough application of the actual cautery, or of nitric acid, the field of operation being subsequently dressed with compresses kept wet with lead water and alcohol.

In all these cases of gangrene the constitutional treatment should receive careful attention and should be supporting and stimulating. Iron, quinine, and nux vomica are the tonics of choice. Potassio-ferric tartrate has been particularly recommended. Cod-liver oil will be found beneficial in perhaps the majority of cases.

The chronic phagedenic chancroid and the serpiginous sore are so invariably associated with constitutional dyscrasia that local treatment alone is powerless to effect a cure. Often the underlying lesion is syphilitic in nature and appropriate specific treatment will be followed by cure. Frequently it is tubercular or is dependent upon visceral lesions. In any case general treatment is of cardinal importance. This should be tonic and supporting in type. Stimulants, cod-liver oil, the hypophosphites, and arsenic render valuable service. Locally the lesion should be treated in accordance with the condition of the granulating surface: thus, applications of silver nitrate ten per cent., or copper sulphate of equal strength, followed by dusting with iodoform, will sometimes be followed by good results. Usually these and other mild methods of treatment are perfectly futile. In such cases cauterization of the entire lesion, followed by packing with iodoform gauze and the application of an antiseptic dressing, may accomplish a cure. In some instances a continuous warm bath, lasting for days or even weeks, has caused lesions to heal which had resisted every other form of treatment. This bath may be made mildly antiseptic by the addition of boric acid or sublimate; though the results seem to be equally favorable when water alone is employed. Occasionally such cases recover when complete change of air and surroundings is made, supplemented by ordinary clean dressings.

Lymphangitis.—This comparatively rare complication of chancroid is treated in accordance with general surgical principles; that is, the chancroid should be cleansed and drained, the penis should be elevated and swathed in cloths wet with evaporating lotions, and the patient should be kept quiet on a light diet, and should have his bowels thoroughly opened. Usually resolution takes place. Fluctuation denotes that pus has formed. This should be evacuated by a small puncture made with all antiseptic precautions, and the cavity washed out with peroxide, followed by bichloride 1 to 2000, and sealed up with an iodoform gauze collodion dressing. In case of reaccumulation the evacuation and washing are repeated. If inflammatory phenomena become pronounced, the abscess-cavity should be freely opened and packed with iodoform gauze. These abscesses become chancroidal only because of inoculation from without.

Lymphadenitis or Bubo.—This complication of chancroid will usually be avoided when the lesion is kept thoroughly clean and well drained from the first and when the patient remains quiet. Even when the glands have begun to swell, as evidenced by pain and tenderness in the groin and the detection of a distinct lump, further enlargement can often be prevented by rest in bed, the administration of a saline purge, and the application over the affected region of heat and pressure. This is best applied by means of lint wet with dilute lead water. Over this is laid the ordinary rubber hot-water bag, fastened in place by one or two turns of a spica, the patient lying on his back in bed, scrupulous attention being paid at the same time to the cleansing of the chancroid.

When this treatment by rest in bed and application of heat is not practicable, there may be placed over the sore the following ointment:

℞ Ung. hydrargyri,
Ung. iodi comp.,
Ung. belladonnæ,
Ung. petrolei carbolat., āā ʒii.

Over this is placed a compress, and firm pressure is made on the gland by means of a spica bandage.

After twenty-four hours of this treatment, if there is no improvement, and particularly if the pain, swelling, and inflammatory phenomena are more marked, time and suffering will be saved the patient by administering ether and then proceeding at once to excise the affected gland or glands, since it is almost certain in these cases that suppuration will take place. The excision is conducted in accordance with the principles of modern surgery. All enlarged glands are shelled out, and the wound is thoroughly cleaned, and is closed without drainage. When patients object to this radical treatment,—and this will be in the majority of cases,—an effort should be made to cause resolution by the injection of antiseptic solutions into the substance of the inflamed gland. The drug most employed is benzoate of mercury in one per cent. solution. From ten to fifteen drops of this are driven directly into the inflammatory focus. Antiseptic compresses and a pressure bandage are then applied over the affected region. This is followed by increase of swelling for twenty-four hours, but after this resolution usually takes place. In place of the benzoate of mercury a three per cent. solution of carbolic acid may be employed in equal quantity, ten to twenty minims being injected at one time.

If suppuration occurs in spite of this treatment, or, when a case first comes under observation, if there is fluctuation, the abscess-sac should be punctured under antiseptic precautions, its contents squeezed out, and ten per cent. iodoform glycerin emulsion injected under moderate tension. The cavity should be emptied and refilled twice; as much as will remain of the third filling should be left in, and over the seat of abscess-formation should be placed a large absorbent antiseptic dressing. If, following this operation, there is reaccumulation of fluid in the abscess-cavity, it should again be evacuated by puncture and injected with the iodoform emulsion. If more than two punctures are required, the cavities should be freely incised, gently curetted, packed with sterile iodoform gauze, and dressed antiseptically.

If when the case comes under observation there is a large abscess with the overlying skin livid and devitalized, or already ulcerated through, the cavity should be opened by a free incision parallel to Poupart's ligament. Careful search should be made for glands beginning to soften but not yet completely broken down, which should be removed either by means of blunt dissection with the finger, or by careful cutting with the knife. The whole wound cavity should be thoroughly curetted, and should be packed with sterile iodoform gauze. Any sinuses which may form must be followed to their end, being freely slit open to the surface. This operation sometimes results in an enormous wound, but no hesitation should be felt in making it, since otherwise ultimate cure is uncertain.

When that form of inflammation is encountered which is sometimes seen in tubercular cases,—that is, when gland after gland enlarges and slowly breaks down, its capsule becoming firmly adherent to the surrounding parts and the whole forming a large lobulated tumor,—removal by careful dissection is the only means of treatment which will be followed by cure. In these cases the glands sometimes contract adhesions to the femoral vein, and a number of deaths have been recorded from the wounding of this vessel in the course of an operation. Following the dissection the wound is packed with iodoform gauze.

When the bubo has ruptured before it has come under observation, and when it is infected with the ordinary pyogenic microbes, in addition to free incision and curetting it is well to paint the whole raw surface with a solution of zinc chloride, sixty grains to the ounce, subsequently packing with iodoform and dressing the wound as before described.

When a bubo becomes chancroidal in type, the resultant sore should be treated in accordance with the principles governing the treatment of chancroid. Thorough cauterization will usually be followed by prompt cure. If cauterants cannot be employed, applications of the ordinary antiseptics are often efficacious. These chancroidal buboes are of course subject to the same inflammatory complications as are chancroids of the penis.

The after-treatment of buboes which have been operated on is comparatively simple. Rest in bed is advisable for at least from five to seven days, since thus the parts will be kept quiet. A spica of the groin holds the dressing in place. This is to be changed in accordance with the strictest antiseptic principles, since it is possible at any time to have the ulcerating surface inoculated with the chancroidal virus. In some instances healing goes on more rapidly when the patient is allowed to be up and about than when he is kept in bed. If, however, walking or sitting in the erect posture retards healing, the patient should be kept in bed until convalescence is established.

The treatment of chancroidal buboes may be summarized as follows. 1. Buboes are to be avoided by thorough frequent cleansing of the chancroids and by rest upon the part of the patient. 2. They may be aborted in their earliest stages by active purgation, by rest in bed, and by the application of heat and pressure. If in twenty-four hours abortive treatment is not followed by improvement, no further effort should be made in this direction. 3. If the bubo is steadily progressing in spite of appropriate treatment, excision before softening has occurred offers the quickest method of cure. 4. When this is not practicable, injections of antiseptics into the substance of the diseased glands, followed by pressure and rest, will often bring about resolution. 5. When softening has occurred, but the skin is not yet involved, evacuation of the contents of the abscess through a small puncture, followed by iodoform injection or antiseptic irrigation and the application of a pressure bandage, will favor resolution. 6. If after this treatment once repeated the abscess-cavity again fills, or if the abscess is large and the skin is already partly devitalized, the abscess should be opened by free incision parallel with Poupart's ligament, all enlarged glands should be shelled out or excised, all sinuses should be followed to their extreme limit and opened freely, and the ulcerating wound should be packed with iodoform gauze. 7. This same treatment should be applied to buboes which have already opened spontaneously, and should be supplemented by the application of zinc chloride, sixty grains to the ounce, to the curetted surfaces. 8. The tubercular type of bubo requires excision of all the enlarged glands. 9. All operations on chancroidal buboes should be conducted with scrupulous regard to the principles of antisepsis.

Chancre of the penis and the ulcerative lesions of the secondary and tertiary stages of the disease are discussed under Syphilis.

TUMORS OF THE PENIS.

Tumors of the penis may be cystic or solid, benign or malignant.

Under the **benign tumors** are included the cysts, sebaceous, blood, and mucous, papilloma, horny growths, lymphangioma, fibroma, and adenoma. Except papilloma, these lesions are rare.

The **malignant tumors** include carcinoma, sarcoma, and epithelioma. The latter is by far the commonest form of cancerous growth. Carcinoma and sarcoma are sometimes observed in infants.

Cysts, fibroma, angioma, etc., are so rarely observed, and when seen coincide so completely with similar growths of other parts of the body, that they require no detailed mention. Sebaceous cysts are occasionally seen in the prepuce. Cysts from distention of Tyson's glands may be multiple, and sometimes reach large size. Angiomata have caused troublesome bladder reflexes.

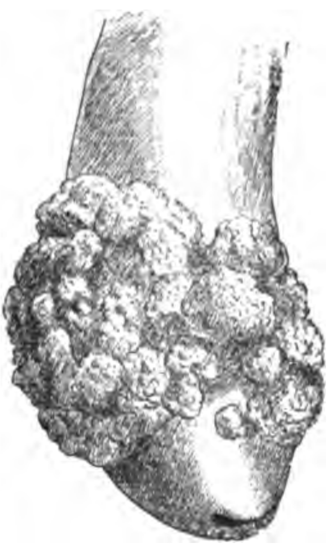
The *treatment* is the same as that appropriate to like conditions in other parts of the body,—*i.e.*, removal when they are increasing in size or cause pain or interfere with function.

Lymphangioma, or **elephantiasis,** rarely involves the penis alone; usually the scrotum is implicated. When secondary to inflammation or removal of the inguinal glands it may be self-limited and transitory. Operation may be required. (See page 624.) The filaria may or may not be found. The diagnosis is nearly always rendered easy by a history of preceding inguinal adenitis or by the associated thickening of the skin of the scrotum and lower extremities. When the foreskin is primarily attacked, at least in the early stages, it may be difficult, and at times even impossible, to decide whether the overgrowth is due to infiltration consequent upon a chronic balanoposthitis, or to elephantiasis. The steady progress of the infiltration, in spite of local cleanliness, would in a short time lead to a correct diagnosis.

Verrucæ or Papillomata.—Venereal warts appear as small or large, discrete or confluent, moist or dry papillary overgrowths, usually springing from the coronary sulcus, the posterior border of the glans penis, the inner surface and margin of the prepuce, the region of the frænum, and the orifice of the urethra. (Fig. 28.)

Pathologically these outgrowths are found to be due to hypertrophy of the papillary and mucous layers of the skin. At the same time there is a corresponding development of blood-vessels. On the mucous surfaces they are moist, from maceration of the epithelial covering; on the skin surfaces, as the penis, scrotum, or thigh, they are generally dry.

FIG. 28.



Venereal warts.

The cause of venereal warts can usually be traced to irritation incident to prolonged contact with inflammatory discharges. Thus, in the uncleanly, in those suffering from gonorrhœa, herpes, chancroid, or balanoposthitis, papillary outgrowths are by no means uncommon. The most important predisposing cause is a redundant or phimotic foreskin. In addition there seems to be in certain persons a constitutional predisposition towards papillary outgrowths. Proof as to the contagious nature of discharges from venereal warts is still wanting. though there are many recorded cases of condylomata developing apparently as the result of contagion.

Symptoms.—Condylomata are found most often in men between the fifteenth and the twenty-fifth year, and in those who give a history of inflammation about the genitalia, either from disease or from redundant foreskin. They appear as markedly vascular outgrowths from either the skin or the mucous membrane. Sometimes they project like one or more threads, or may form discrete, small-sized, tuberous excrescences, or by confluence may produce an outgrowth resembling a raspberry or a cauliflower. The confluent warts often assume the shape into which they are moulded by the pressure of the surrounding parts ; thus, under the prepuce, pressed beneath the foreskin and the glans, they may be flat and broad like a cock's comb.

Diagnosis.—Venereal warts may be confounded with the mucous patch or condyloma lata, and with epithelioma.

The condyloma lata or mucous patch rarely appears as an isolated lesion of syphilis; the concomitant signs of the disease and a history of the case usually indicate the nature of the affection, though it must not be forgotten that syphilis may excite true papillary overgrowth almost identical in appearance with the overgrowth of condyloma acuminata.

Epithelioma usually occurs after middle life. It *ulcerates*, grows rapidly, involves the surrounding tissues in a dense infiltrate, and is accompanied by a characteristic induration of the inguinal glands.

A wart found upon the sexual organs of an old person, even if characteristic in appearance, should always excite suspicion, since this benign neoplasm is comparatively rare after middle life, while malignant growths are by no means uncommon, and in their early period closely resemble the venereal wart.

At the time the differential diagnosis is most important, *i.e.*, in the beginning, it is most difficult. It should be remembered that even at this period of the disease the malignant growth infiltrates the tissues from which it springs.

Only by means of microscopic examination of sections from the outgrowth can a positive opinion be given, since clinical experience shows that the benign neoplasm is at times transformed into a malignant growth.

Prognosis.—Venereal warts, if kept clean, and protected from mechanical irritation, spontaneously disappear, though predictions as to when this result will occur can never be made with safety. If utterly neglected, they ulcerate and suppurate, and may often be complicated by inflammatory buboes or by sloughing and gangrene. Exceptionally they form the starting point of cancer.

Treatment.—Complete removal of the papilloma constitutes the only reliable treatment. Where the outgrowths are discrete and small, each is seized in a pair of rat-tooth forceps, drawn upward, and removed, together with the tissues of its base, by a snip of the scissors after having had injected beneath its base a drop of a one per cent. solution of eucaine. If the warts spring from the glans, the little bleeding points left by this cutting are touched with pure carbolic acid, and the dressing is completed by dusting with iodoform or other powder, and, if necessary, applying a clean narrow gauze pressure bandage. The wound left by snipping warts from the prepuce is at once closed by suture without cauterization. When the neoplasm has a large base, the whole outgrowth may be shaved off level with the surrounding surface by means of a sharp, flat knife. The wound left by this incision should be thoroughly curetted, and then should be cauterized with carbolic or nitric acid and dressed with iodoform or with a powder made of calomel and zinc oxide, equal parts of each. General anæsthesia is required for this operation. Only spouting vessels should be ligated, the free primary oozing being readily controlled by the application of adrenalin chloride solution (1 to 1000).

At the time this operation is performed an effort should be made to remove the exciting cause of the lesion. Thus, phimotic patients should be circumcised, urethral discharges should be prevented from coming in contact with the external parts, etc.

When operation is refused, warts may be removed by nitric acid. The surrounding surfaces should be protected by the application of cosmoline; the acid is well rubbed into the wart and a boric ointment dressing is applied. The application is repeated every second or third day until the papillary layer of the skin is destroyed at the point of outgrowth.

Chromic acid is an excellent application, but is open to the objection that occasionally it gives rise to general toxic symptoms. Fatal cases have been reported. It is usually employed either pure or in a ten per cent. solution, brushed over the outgrowth once daily.

Certain non-cauterant remedies are advised, and at times give good results, possibly because of the spontaneous tendency towards healing exhibited by the condylomata. Among these may be mentioned the following:

℞ Acidi salicylici, ʒi;
Acidi acetici, f℥i.
M. S.—Apply with a brush once daily.

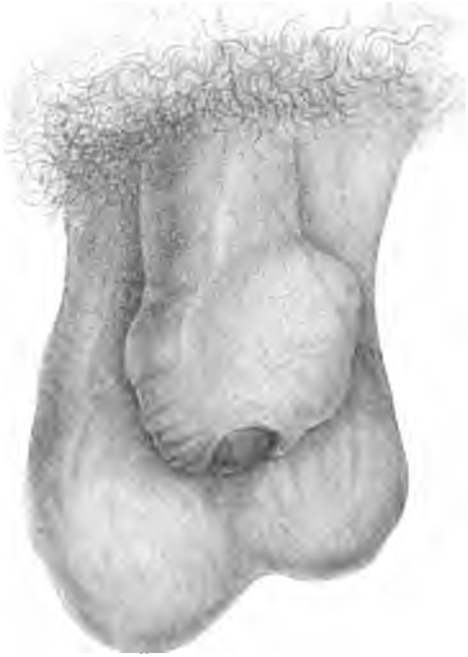
The effect of irritants not strong enough to act as cauterants is to stimulate the papillary outgrowths.

Horny Growths of the Penis.—In the few reported cases of this affection the growth has sprung from the surface of the glans penis of old men. It is an extremely rare manifestation of perverted epidermic hypertrophy. It is easily recognized, and its main pathological importance lies in the fact that it is at times the forerunner of cancer. The appropriate treatment is the thorough removal of the horn, together with the base from which it grows. When the patient is advanced in years and there is no indication of epitheliomatous degeneration, surgical operation is not indicated.

Malignant Disease.—With the exception of epithelioma, malignant disease of the penis is extremely rare.

A few cases of medullary cancer have been described. These develop about the period of puberty, and are apt to be consequent on trauma. They form rapidly growing, lobulated, painful tumors. The lobules may be so soft as to suggest the formation of a cyst. There are usually the phenomena of subacute inflammation, and the lymphatic glands of the groin are quickly involved. Amputation carried wide of the disease is the only treatment, and even if this procedure be adopted early, the ultimate outlook is extremely unfavorable.

Fig. 29.

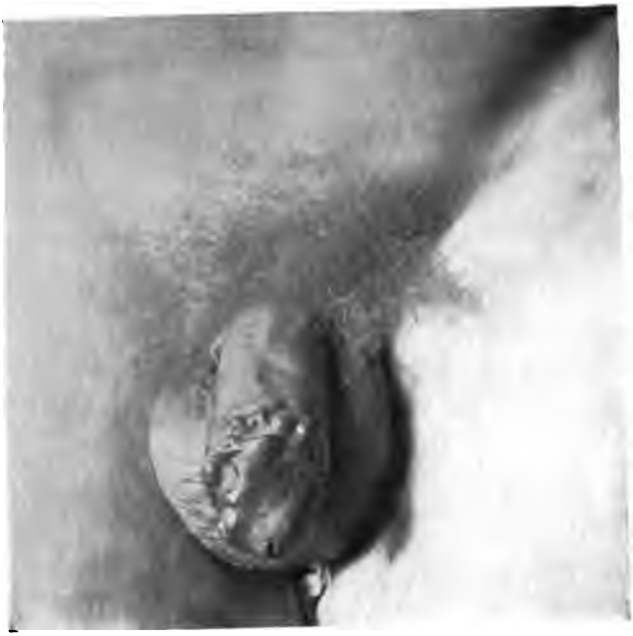


Epithelioma. (Demarquay.)

Epithelioma commonly appears on either the glans or the prepuce. It may assume the superficial or the infiltrating form. (Fig. 29.) It usually develops after middle age, and sometimes grows from the seat of a former chancre.

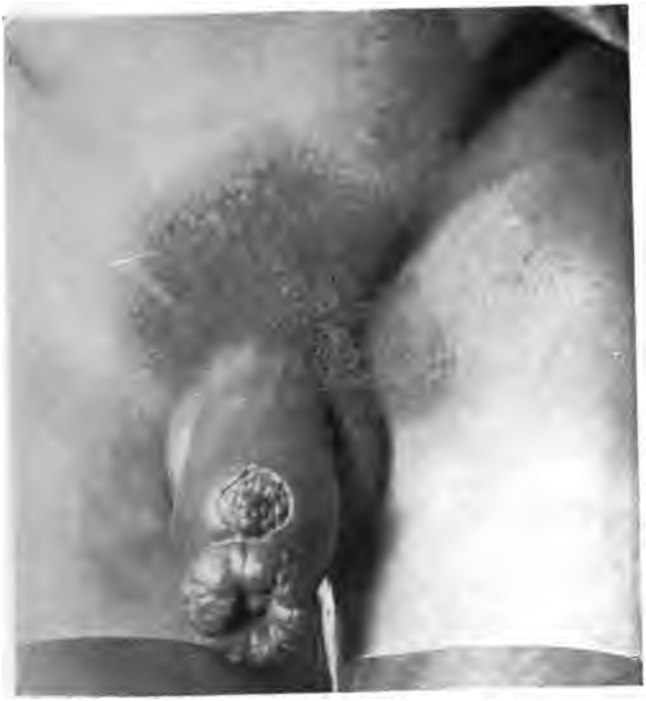
Symptoms. — Epithelioma generally appears first in the form of a wart, which becomes excoriated, ulcerated, and shortly indurated. The disease, beginning as a small ulcerative vegetation, gradually extends until a large portion of the prepuce and glans is involved. (Fig. 30.) The ulceration has a hard base and is irregularly excavated. Together with the deep ulcers there are often cauliflower-like outgrowths. (Fig. 31.) The surrounding skin is infiltrated, œdematous, nodular, elevated, and purplish in color. The glans is greatly swollen, irregular in outline, and lobulated.

FIG. 30.



Epithelioma, ulcerating form

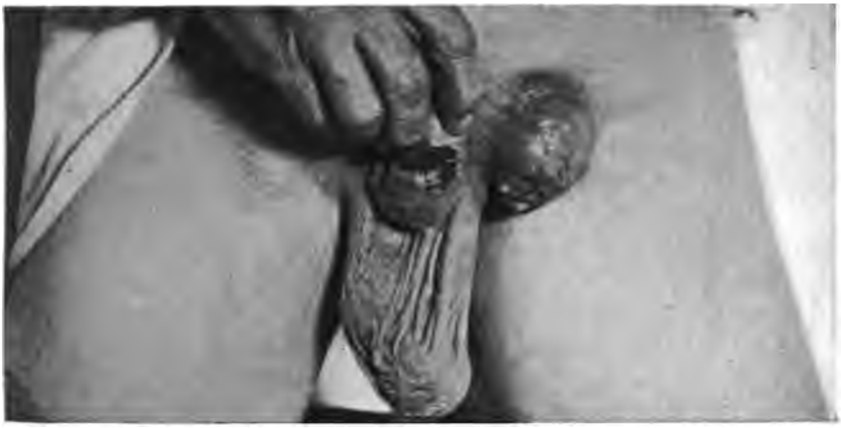
FIG. 31.



Epithelioma, vegetating form.

As the disease extends backward the cavernous bodies become indurated and the overlying skin, at first slightly adherent, is involved in the disease. Finally the lymphatic glands of the groin become infiltrated and ulcerated, and discharge fetid, blood-stained pus. (Fig. 32.)

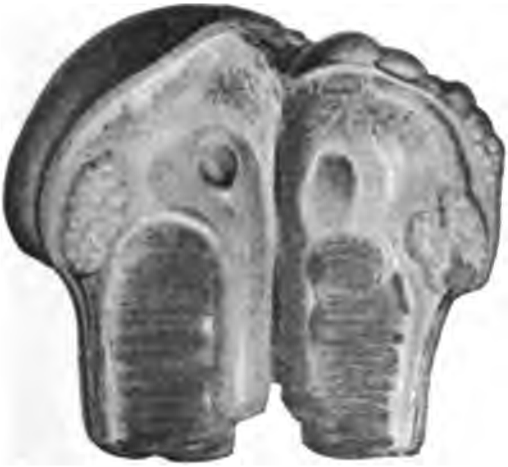
FIG. 32.



Epithelioma with glandular involvement.

Etiology.—The presence of a redundant or phimotic foreskin, accumulations of smegma, subpreputial calculi, chronic balanoposthitis, specific or non-specific ulcerations, indeed, any source of local irritation, may act as a predisposing cause for the development of epithelioma.

FIG. 33.



Cross-section showing infiltration of an epithelioma. (Demarquay.)

Diagnosis.—This is difficult only in the early stages of the disease.

When without obvious cause a warty growth develops on the glans or the foreskin in a person past middle life, this lesion should be carefully watched. Induration about the base (Fig. 33) or ulceration of the excrescence would justify the diagnosis of epithelioma, and would indicate a prompt removal.

Prognosis.—The prognosis of epithelioma is grave unless operation is undertaken in its very earliest stages. The course of the affection varies greatly in different cases. Some patients perish in two months, others survive for many years. When the inguinal glands are involved there is but slight chance of ultimate recovery.

Treatment.—The only treatment to be considered in these cases is entire removal of the diseased part. When the disease has not developed further than slight ulceration of an indurated papule, total excision of the involved area, with subsequent cauterization of the excision wound by means of caustic potash, may suffice.

When epithelioma is fairly developed, amputation carried wide of the disease is the only resource. The inguinal lymphatic glands should be removed at the same time, even though not enlarged.

SYPHILIS OF THE PENIS may be mistaken for epithelioma, but may be recognized by the characteristics described under this subject.

PARTIAL AMPUTATION OF THE PENIS.—This operation is indicated when the ulceration or infiltration lies an inch or more in front of the peno-scrotal junction. The ulcerating mass having been cauterized with pure carbolic acid and occluded by a dressing wet in 1 to 1000 corrosive chloride, and the inguinal regions having been thoroughly cleansed as for any surgical operation, an incision is carried from the middle of Poupart's ligament to the dorsum of the penis, thence down the middle of this organ to the seat of amputation. The superficial layer of fat containing the glands is then dissected up from each inguinal region and is stripped inward, including the lymphatic vessels of the penis. This mass of tissue, made up of two wings, is carried downward and the Y-shaped incision is closed by suture. Two inches or more behind the epithelioma a stout acupressure needle is thrust through the corpora cavernosa from side to side, and behind this a medium-sized drainage-tube is wound two or three times around the penis and kept in place by catch forceps or by knotting. By a circular sweep of the knife the skin of the penis is divided at the proposed seat of amputation, which should be at least one inch behind the farthest backward extension of the malignant infiltration. Half an inch in front of this the spongy body of the urethra is cut across and dissected back to the level of the skin incision. The corpora cavernosa are then cut through on a level with the first incision, the rubber ligature is removed, the bleeding vessels are secured by means of fine-pointed hæmostatic forceps and by catgut ligatures, and the acupressure pin is taken out. Sutures are then passed drawing together the cut edges of the fibrous sheaths of the cavernous bodies, thus completely covering in the vascular erectile tissue, and both protecting it from subsequent infiltration and infection by the urine and immediately checking oozing. The urethra is split on its floor back to the level of the surface of the divided cavernous bodies. The borders of this incision, together with the divided urethral end, are sutured to the skin. The latter is then stitched so as to cover in the cavernous bodies. The line of suture is dusted with iodoform and is dressed with iodoform gauze. The dressing is held in place by a T-bandage. Continuous catheterization may be employed; it is better, however, to let the patient micturate when desire prompts, removing the dressing to allow of this and irrigating the wound immediately afterwards with corrosive chloride solution 1 to 4000.

Recurrence in the stump after partial amputation is rare, death usually resulting from lymphatic involvement. During a partial amputation, with the help of a freezing microtome, the cross-section should be carefully examined for evidences of malignant infiltration, which if found would indicate a more complete removal. The stump following the partial operation enables the patient to urinate normally and at times to satisfactorily accomplish the sexual act.

Amputation of the Entire Penis.—This procedure is indicated when the disease is so far advanced that partial excision can no longer be considered. Treves describes the operation as follows:

The patient is placed in the lithotomy position, and the skin of the scrotum is incised along the whole length of the raphe. With the finger and the handle of the scalpel the halves of the scrotum are separated down to the corpus spongiosum. A full-sized metal catheter is passed as far as the triangular ligament, and a knife is inserted transversely between the corpora cavernosa and the corpus spongiosum. The catheter is withdrawn, the urethra is cut across, and its deep end is detached from the penis back to the triangular ligament. An incision is made around the root of the penis continuous with that in the median line. The suspensory ligament is divided and the penis is separated, except at the attachment to the crus. The knife is then laid aside, and with a stout periosteal elevator or rugine each crus is detached from the pubic arch. The two arteries of the corpora cavernosa and the two dorsal arteries require ligature. The urethra and corpus spongiosum are split up for about half an inch, and the edges of the cut are stitched to the back part of the incision in the scrotum. The scrotal incision is closed by sutures, and if drainage is used the tube is so placed in the deep part of the wound that its end can be brought out in front and behind. A catheter is usually retained in the urethra.

CHAPTER II.

INJURIES AND DISEASES OF THE URETHRA.

The Anatomy of the Urethra.—The urethra, serving the double purpose of a carrier for the urine and for the semen, is a tubular passage about eight inches in length, of somewhat changing calibre in various parts of its course. Originating from the bladder, it passes through the upper part of the central portion of the prostate gland, pierces the anterior and posterior layers of the triangular ligament about one inch below the lower border of the pubic symphysis, and then, surrounded by the corpus spongiosum, passes on to the meatus.

The prostatic portion of the urethra is about an inch and a quarter long, and is the widest and most dilatable part of the canal; the membranous portion is about three-quarters of an inch long, and is the narrowest, least dilatable part of the urethra, except the meatus. The spongy or penile portion of the canal is about six inches in length.

The meatus is the narrowest part of the urethra. Immediately behind this opening the passage widens somewhat, forming the fossa navicularis. Passing backward, the urethra becomes slightly narrower, and, exhibiting a nearly uniform diameter, traverses the spongy body till it reaches the bulb, or posterior portion of this body, where it again dilates. This dilatation narrows abruptly at the anterior layer of the triangular ligament, the membranous urethra being of small but uniform calibre. After passing through the posterior layer of the triangular ligament the urethra again widens out, reaching its greatest diameter at the position of the caput gallinaginis. Before passing into the bladder there is a slight narrowing, noticeable only when the latter viscus is empty.

There are, then, three regions of physiological dilatation. These are located in the prostate gland, at the bulb, and behind the meatus.

The natural positions of physiological narrowing are at the meatus and the membranous portion of the canal.

The epithelial lining of the mucous membrane of the urethra is flat and laminated near the meatus; in other portions of the tube it is columnar.

The mucous membrane is continuous with the bladder internally and with the integument of the glans penis externally. It is prolonged into the ducts of all the glands which open into the urethra.

The submucous tissue is made up of fibrous and elastic tissue, together with unstriped muscular fibres. These latter are arranged in two layers, one passing longitudinally, the other circularly. This muscular layer is most marked in the prostatic and membranous portions of the urethra; passing forward, it becomes thinner, till in the anterior part of the spongy urethra it is replaced in a great measure by fibrous tissue.

On the mucous membrane of the urethra may be seen the openings of many glands and follicles. These are situated in the submucous tissue. The glands, called the glands of Littre, vary greatly in size, and are most abundant in the spongy portion of the canal and about the meatus. Their orifices are directed forward. The largest of the follicles, called the lacuna magna, is situated in the upper wall of the fossa navicularis, and is one and one-half inches from the meatus.

The spongy portion of the urethra, so named because it is surrounded by the erectile tissue of the corpus spongiosum, extends from the meatus to the anterior layer of the triangular ligament. It is further subdivided into a pendulous and a bulbous portion. The pendulous portion extends from the meatus to the dilatation enclosed by the bulb (about four and one-half inches in length). The bulbous portion or dilatation (about an inch to an inch and a half long) is abundantly supplied with mucous glands and follicles; into it also pass the ducts of Cowper's glands. In direction the spongy urethra first passes upward, then curves downward.

The membranous portion of the urethra, beginning at the prostate gland and ending at the bulb, is separated from the pubic symphysis by muscular fibre and by the dorsal vessels and nerves of the penis; below it lie Cowper's glands. Its upper surface is concave, and is about one-quarter of an inch longer than the lower surface. The perineum separates the lower surface of the membranous urethra from the rectum. In this portion of the urethra the erectile tissue is but slightly developed. In place of this there is a complicated investment of muscular fibres. First there is a layer of unstriped fibres passing circularly and longitudinally. External to this there is an investment of voluntary muscular fibres completely surrounding the urethra. This muscular sheath is named the compressor urethræ.

The prostatic urethra is spindle-shaped,—that is, it is widest at its middle. On the floor of the canal the mucous membrane is projected in the form of a longitudinal ridge, called the verumontanum, or caput gallinaginis. On each side of this ridge lies a depression, called the prostatic sinus, into which open the orifices of the prostatic ducts. Immediately in front of the verumontanum is the sinus pocularis, a blind pouch running upward and backward beneath the middle portion of the prostate gland. At or just within the margin of the sinus pocularis are the slit-like openings of the ejaculatory ducts.

At the point where the prostatic urethra enters the bladder it is surrounded by a muscle made up of unstriped fibres, called the internal vesical sphincter; anterior to this a double layer of unstriped muscular fibres and the glandular structure of the prostate surround the urethra. At the apex of the prostate there is a sphincter made up of both voluntary and involuntary muscular fibres; this is called the external vesical sphincter.

The discharge of urine from the bladder is prevented by the tonic contraction of the muscular apparatus of the membranous and the prostatic urethra. As the bladder becomes distended, the internal vesical sphincter yields, and the urine enters the posterior part of the prostatic urethra, causing a desire to urinate, which is resisted by the action of the voluntary fibres of the external vesical sphincter and the compressor urethræ. On passing a catheter when the bladder is full, the urethra seems about an inch shorter than it does immediately after micturition; this is owing to the participation of the posterior portion of the prostatic urethra in the retentive function of the bladder.

The compressor urethræ muscle is readily excited to reflex spasm. Ordinarily, on the passage of instruments, a moderate degree of resistance can be detected, due to the contraction of this muscle. In irritable conditions of the mucous membrane there may be excited a spasm so violent that it will be impossible to introduce a soft instrument. Such a spasm may also be excited by irritation of the prostatic urethra, either from distention of the bladder or from any other cause. Thus, it is often found extremely difficult to evacuate the bladder when the desire to urinate has been resisted for many hours, and acute inflammation of the posterior urethra not infrequently requires the use of catheters to overcome the tight muscular contraction of the compressor urethræ which prevents micturition. Not only the introduction of sounds, but even the injection of bland liquids, will cause contraction of the compressor urethræ muscle, and hence prevent such injection from reaching the membranous or the prostatic urethra. Any inflammation in these portions of the urethra will also cause the tonic contraction of the sphincter muscles to be accentuated. Hence inflammatory discharge from the membranous or the prostatic urethra will flow not forward, but into the bladder, and injections intended to reach the deep urethra will, if driven in at the meatus, extend no farther back than the anterior layer of the triangular ligament.

There seem, then, to be good grounds, both from a physiological and from a clinical stand-point, for dividing the urethra into an anterior erectile part and a posterior muscular part.

Malformations of the Urethra.—The urethra may be absent, obliterated, congenitally strictured, sacculated, or deficient as to its floor or its roof. Of these anomalies deficiency of the floor and of the roof, entitled hypospadia and epispadia, are most common.

ABSENCE OF THE URETHRA is a malformation usually fatal to the child before birth, since the distended bladder by pressing on the umbilical arteries interferes with the fœtal circulation. Exceptionally the child is born alive with a greatly dilated bladder, in which case the urine may escape through a patent urachus; or by way of the rectum or perineum, fistulæ being formed; or operation by suprapubic or perineal puncture may give relief.

Treatment.—The proper treatment for absent urethra would be the formation of a perineal fistula, the position of the base of the bladder previously having been determined by digital examination through the rectum.

ATRESIA or obstruction of the urethra, usually at one point, may occur at any portion of the canal, but is commonly observed at or near the meatus. The occlusion may be caused by a thin, easily pierced membrane, the variety ordinarily seen near the meatus or in some portion of the anterior urethra; or the urethra itself may be converted into a fibrous cord, a form rarely observed, except in or near the membranous portion of the canal. In these cases fistulæ often form, giving spontaneous relief. Frequently, however, there is retention of urine, with all its disastrous effects upon the bladder and kidneys and upon the system at large. As in the case of absent urethra, the condition usually causes the death of the fœtus.

The diagnosis is founded upon the failure of the child to urinate, the presence of a distended bladder, which sometimes completely fills the belly, and can be felt by abdominal palpation and by digital examination through the rectum, colicky pains, and the discovery of obstruction, either by inspection, when the stoppage is located at or near the meatus, thus allowing the urethra to become distended behind the point of blocking, or by instrumental examination, if the visible portion of the urethra seems normal.

Treatment.—The treatment, when the obstruction is at or near the meatus, consists in opening the obstructed portion of the urethra by means of a trocar and canula, a tenotome, or a small sound. When it is placed deeper it would seem advisable to pass a sound down to its anterior face and make an attempt by gentle pressure exerted in the proper direction to pass through it. Having succeeded in introducing an instrument and evacuating the urine (not all at one sitting, in case of great bladder distention), the sound is passed through the seat of obstruction at intervals of three days for several weeks.

When instruments cannot be introduced, the membranous and prostatic portions of the urethra should be opened by external perineal urethrotomy, and the posterior limit of the obstruction determined by passing an instrument from behind forward; or if the occlusion extends well back into the membranous urethra the same result may be accomplished more readily by performing suprapubic cystotomy. The position and the extent of the urethral obstruction having been exactly determined by one instrument passed from the meatus backward, and by another passed from the membranous urethra or the bladder forward, the urethra may be rendered pervious either by instruments cutting from within, a long knife passed through an endoscopic tube, for instance, or by an external urethrotomy, followed by plastic operation. Unless the obstruction be limited to a thin membrane, external operation will be required. An attempt may be made to repair the defect in the urethral lining by transplanting mucous membrane from the cheek. This is held in place by a few catgut sutures and the permanent catheter, the skin opening being closed by suture. The catheter is left in place six days. Regular dilatation is necessary in the after-treatment.

CONGENITAL STRICTURES, if the usual narrowing at or just behind the meatus be excepted, are extremely rare. If present, they will be denoted by slow dribbling urination, with increased frequency, dilatation of the bladder, and colicky pains. Such strictures should be treated by gradual dilatation; this failing, urethrotomy is indicated.

Very exceptionally narrowing of the meatus becomes so extreme that the act of micturition is seriously interfered with. There is usually an associated phimosis, which hides the real seat of obstruction. Meatotomy should be performed immediately, the meatus being kept patulous by the regular passage of bougies till healing is complete.

VALVULAR FOLDS have been found post mortem in the prostatic urethra, with characteristic changes of bladder, ureters, and kidneys, showing that they had occasioned fatal obstruction. Such folds are also found about the junction of the penile and the glandular urethra.

The diagnosis is difficult, and will be founded on slow, difficult, frequent urination, bladder distention, and colicky pains associated with a urethra which readily admits a small sound.

The urethroscopic tube (No. 12 to 14 F.) might render both a diagnosis and treatment by cutting practicable in the case of prostatic valves. The bulbous bougies should find anterior valves; these are readily divided by a tenotome.

URETHRAL POUCHES or diverticula may sometimes reach large size. They develop from the floor of the urethra, and in the cases described were found just behind the glans. They were not associated with stricture, but seemed to be dependent for their formation on absence of the erectile tissue, leaving a thin urethral wall which gradually dilated. These congenital pouches are associated with incontinence of urine. They become distended with each act of micturition, and there is subsequent dribbling from the slow leakage of the urine contained.

Diagnosis.—A diagnosis is readily made from the distention observed during the act of urination and from the absence of inflammatory reaction.

Treatment.—The treatment consists in removal of the redundant walls of the pouch and suture of mucous membrane and skin so that the calibre of the resulting urethra at the point of operation shall be about normal.

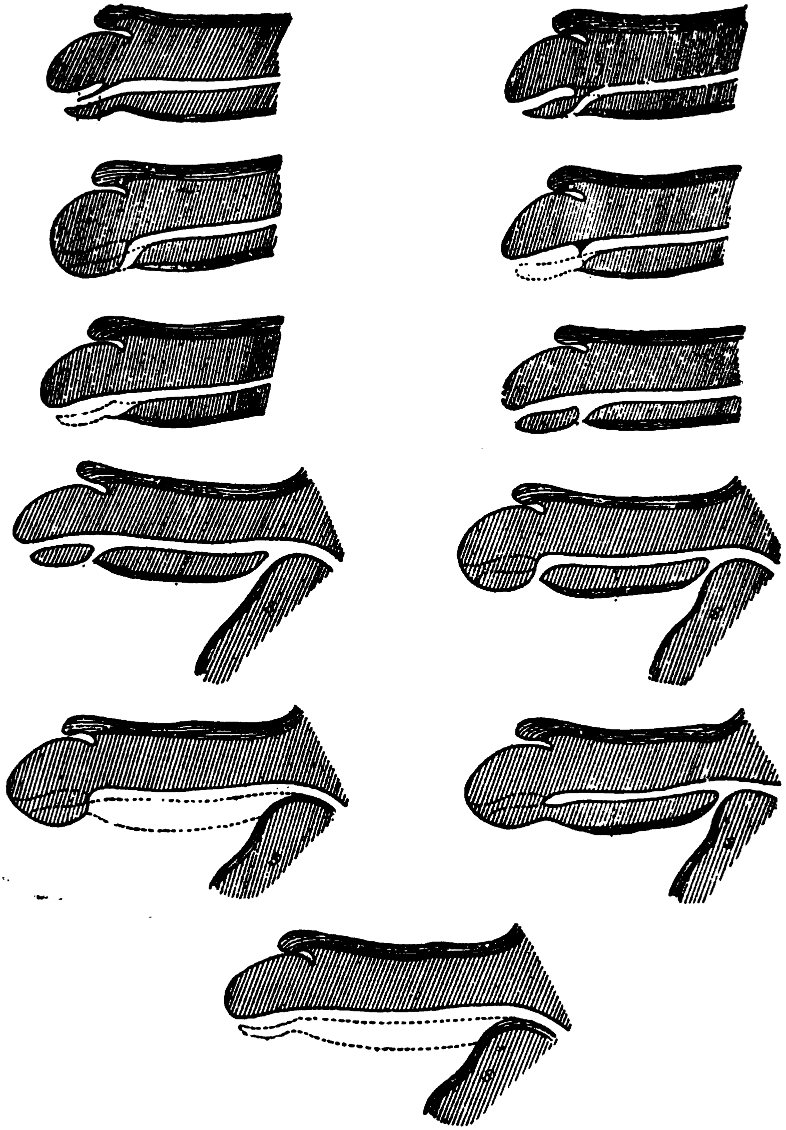
As an unusual anomaly the urethra, on inspecting the glans, seems to be double or multiple. Exploration of these openings will show one or more blind pouches, the urethra opening by a single orifice. Or in case there is a second channel passing parallel with the urethra, this is probably a continuation of the ejaculatory ducts.

Hypospadia.—This defect depends upon a congenital deficiency of the floor of the urethra, which channel, instead of being continued to the glandular meatus, opens at some point on the lower surface of the penis. The deformity is fairly common, being counted by Bouisson once in three hundred males. It is distinctly congenital. Duplay describes two chief forms of hypospadia: (1) that in which the urethra is absent in front of the abnormal opening, this being the common form, and (2) that in which the urethra exists in front of the opening, an extremely rare form.

In regard to the position of the opening, hypospadia is classed as (1) balanic, or glandular, the urethra terminating at the base of the glans; (2) penile, the urethra terminating at a point between the glans and the peno-scrotal junction (Fig. 34); (3) perineal, including under this heading the perineo-scrotal forms, where the urethra terminates in the scrotal cleft.

Cause.—The cause of hypospadia is obviously an arrest of development. The prostatic and membranous portions of the urethra, the penile portion, and the glandular portion are each developed separately. The anterior urethra represents, in the early part of its development, simply a groove, which as the fœtus grows older is closed

Fig. 34.

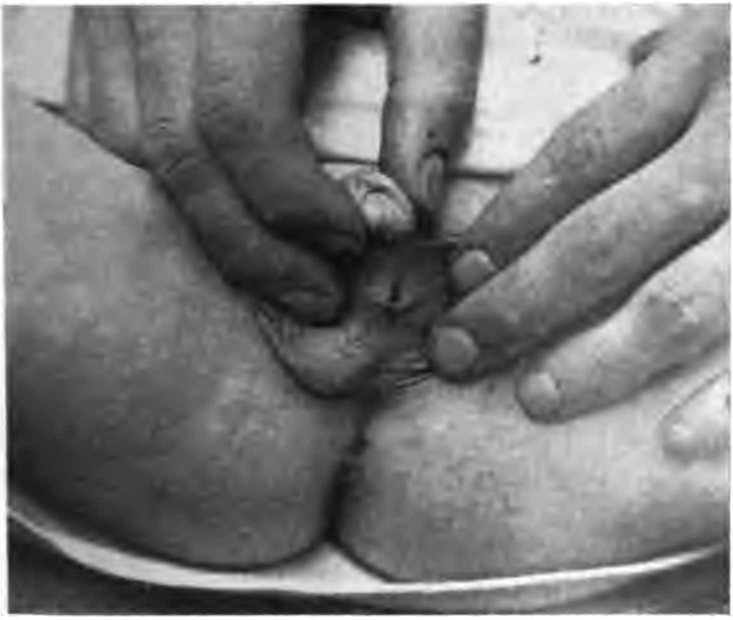


Forms of penile hypospadia. *S*, scrotum. (Kaufmann.)

from behind forward. Failure to close any portion of this groove, or failure of any of the three separately formed portions of the urethra to unite, will occasion hypospadia. Kaufmann attributes hypospadia to obstruction of the urethra persisting after urine has been secreted by the kidneys. In consequence of retention the urethra ruptures behind the seat of obstruction.

BALANIC OR GLANDULAR HYPOSPADIA is characterized by a rather broad glans, curved somewhat downward, and covered on its dorsal surface by a thickened hood, representing the malformed prepuce. The frænum is absent, and the urethra terminates usually in a very small opening at the base of the glans, being continued forward by a narrow groove, representing the upper wall of the navicular fossa. (Fig. 34.) A normally placed meatus is often found, but this is simply a blind pouch. The cavernous bodies are well formed. Other deformities occasionally complicate balanic hypospadia; thus, the penis may be twisted, the cavernous bodies may be stunted or absent, the testicles may be undescended, or the penis may be adherent.

FIG. 35.



Peno-scrotal hypospadia.

PENILE HYPOSPADIA.—The opening is usually found either just behind the glans, midway between the glans and the peno-scrotal junction, or at this junction. (Fig. 35.) The penis in these cases is often curved downward, the cavernous bodies are sometimes poorly developed, and nearly always the prepuce is redundant. Associated deformities are more frequently encountered in this class of cases when hypospadic openings are placed at or near the peno-scrotal angle. Anterior to the abnormal opening the urethra is generally wanting entirely, or it may appear in the form of a groove, or there may be a fibrous ridge extending from the glans to the opening. Rarely the meatus and some portion of the urethra back of this may be preserved, terminating in a blind pouch; or the urethra may continue anterior to the hypospadic opening, ending in a cul-de-sac before it reaches the meatus; or the urethra may be continuous to the meatus, hypospadia then simply representing congenital fistula. The scrotum is not cleft in penile hypospadia.

PERINEAL HYPOSPADIA represents the most inveterate form, and that characteristic of the most marked interference with development. The scrotum is divided by a deep cleft into two lateral halves, in each of which there may be placed a normal testicle, though usually these organs are only partially developed, and frequently have not descended. In this case the scrotal flaps closely resemble the labia majora. The penis is stunted, except in its glandular portion, and is curved downward and backward towards the scrotal cleft. On raising it there is seen a funnel-shaped depression, in the deepest part of which the urethra opens by a vertical slit, provided at either side with a muco-cutaneous fold, suggesting the arrangement of the labia minora. These folds pass forward along the under surface of the penis and the glans, constituting either a groove or a ridge, representing the absent urethra. The glans is broadened and incurved, mainly owing to imperfect development of the lower portion of the cavernous bodies; here the fibrous envelope is extremely thick, and the septum between the two corpora cavernosa in some cases participates in the contraction.

Glandular and penile hypospadia do not necessarily interfere with either micturition or the procreative function. By lifting the glans the urine may be projected in an almost normal direction, and, unless incurvation is more than usually marked, sexual congress is possible, but fecundation is doubtful. In the scrotal and perineal varieties the functions of both micturition and copulation are materially interfered with. The backward curve of the urethra obstructs the stream, which is driven out with some force; the urine is usually sprayed in all directions, requiring the patient to micturate in the sitting position if he wishes to avoid soiling his clothing. On erection the incurvation of the organ becomes even more marked than before; thus copulation is impossible.

Diagnosis.—The diagnosis is not difficult to make, a simple inspection, especially when the patient urinates, sufficing, although in one case we observed a practitioner had endeavored for three years to catheterize a penile hypospadic through the cul-de-sac representing the glandular urethra.

Under some circumstances the determination of sex is extremely difficult in cases of perineal hypospadia. Careful examination through the rectum combined with abdominal palpation will in some cases show the presence of either a prostate or a rudimentary uterus, thus enabling the surgeon to give judgment as to the sex which the case most nearly resembles.

Prognosis.—The prognosis of hypospadia, from both a functional and a cosmetic stand-point, is fairly good when the testicles have descended and are normal in size.

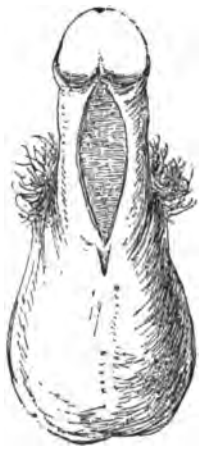
Treatment.—The treatment consists in correcting the incurvation and restoring the urethra to its natural position and length. This end is accomplished by plastic operations. These should be performed in successive stages. The first has for its object the straightening of the penis; the second makes a new canal from the normal position of the meatus and the neighborhood of the hypospadic opening; the third joins this newly formed canal with the posterior portion of the urethra.

The first stage, straightening the penis, is accomplished by a transverse incision across the under surface of the penis, dividing the fibrous ridge which so frequently passes from the hypospadic opening to the glans, and including in this division the thickened, contracted sheath covering in the surface of the cavernous bodies, and also, if necessary, a portion of the septum between these two bodies. The incision can be carried as deep as is necessary for complete straightening of the curve. This often implies section into the substance of the cavernous bodies. When the penis has been straightened the wound is united by means of sutures, so that its long axis is at right angles to the line of the original incision. (Figs. 36, 37.) The wound is dressed with a narrow strip of sterile gauze secured in place by a film of cotton over which is painted collodion. A few turns of a narrow gauze bandage are then applied, and the penis is held upward against the body between two layers of cotton, a crossed of the perineum roller bandage or a jock-strap securing it in place. Stitches are removed in five days. The penis is subsequently held by dressings in the same position till the next step in the operation is undertaken.

At the time the penis is straightened a portion of the second stage—*i.e.*, the formation of the glandular urethra—is accomplished.

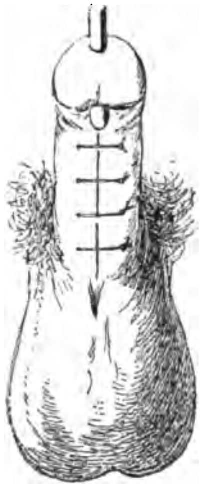
Where there is a deep furrow representing the roof of the urethra, freshening of its lower edges and apposition by suture may be sufficient. Usually a deep vertical incision or two lateral incisions, one on the upper and outer wall of each side of the groove, will be required. In the furrow thus deepened is laid a section of catheter corresponding in circumference to the normal calibre of the urethra, and the freshened edges of the furrow are neatly approximated by suture, two or three silk threads being used. (Fig. 38.) These are removed in five days. It is often difficult to keep the section of catheter in the penile urethra thus made. This trouble may be overcome by taking a piece of small catheter sufficiently long to tie a knot in each end. Before proceeding to the formation of the penile urethra it is well to wait for some months, to determine whether or not incurvation of the penis will be reproduced by contraction.

FIG. 36.



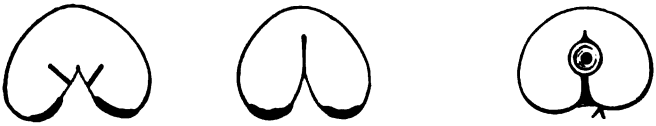
Penis straightened after transverse cut of lower surface.

FIG. 37.



Transverse wound sutured longitudinally: glandular urethra formed.

FIG. 38.

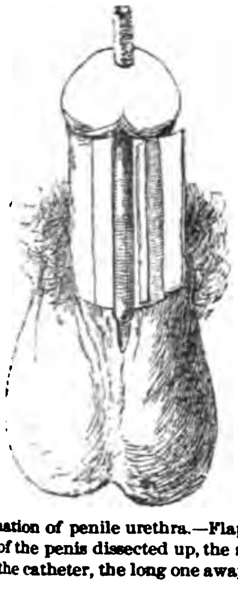


Freshened areas and incisions made in forming glandular urethra.

Glandular urethra closed by sutures.

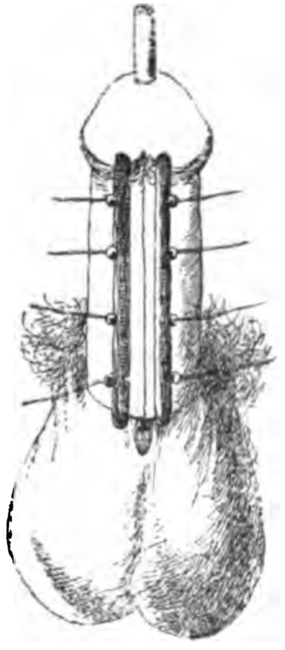
The second stage—*i.e.*, the formation of a canal from the glans to the bladder—is performed by Duplay as follows: Through a perineal opening a Guyon self-retaining catheter is placed in the bladder. The penis is held up, and two parallel incisions are made in the lower surface, each one-eighth of an inch from the middle line and extending from the glans to within a short distance of the hypospadic opening. From the ends of each of these a transverse incision is made towards, but not quite to, the median line. This leaves a median strip of skin a quarter of an inch wide, which is to serve as the roof and sides of the new urethra. Short flaps are raised from these incisions towards the middle line, the skin being dissected free on each side for about a sixteenth of an inch, and long flaps are raised away from the middle line. (Fig. 39.) A catheter of normal urethral calibre, from 12 F. to 16 F., depending on the size of the penis, is passed through the artificially formed glandular urethra and along the course of the proposed penile portion of the tube. The two inner flaps are lifted so that their skin surfaces are in apposition with the sides of the catheter. No effort, however, is made to form them of sufficient length completely to encircle the instrument. The long external

FIG. 39.



Formation of penile urethra.—Flaps on the left side of the penis dissected up, the short one towards the catheter, the long one away from it.

FIG. 40.



Formation of penile urethra completed.

flaps are then brought over the catheter, and should be loosened so thoroughly that they cover it and the shorter inner flaps completely without undue tension. The anterior extremities of all the flaps are then united to the freshened border of the glans, thus completing the anterior portion of the tube.

The stitches, of very fine silver wire, do not include the edges of the short inner flaps. They are placed a fifth of an inch apart, and are passed through apertures in small pieces of lead tubing or in sections of soft rubber catheter (No. 12 F.), one on each side of the wound, and of the same length as the latter. The edges of the long flaps are accurately adjusted and held in place by shot slipped over the ends of the sutures and clamped against the lead pipes or pieces of catheter, thus forming a modified quill suture, (Fig. 40.) Ordinary interrupted catgut sutures may be applied wherever the apposition is not perfect. These are always required to unite the anterior portion of the skin flaps to the posterior lower portion of the glans and to the hypospadic opening, which must be freshened before the sutures are passed. By this operation a canal is formed, partly of the raw surface of the two external long flaps and partly of the skin surface of the two short inner flaps. A strip of iodoform gauze is placed over the line of suture, and is secured in place by a film of sterile cotton and iodoform collodion. The catheter over which the new urethra is formed is withdrawn till its eye lies just to the bladder side of the new urethra, and is held in place by threads which are fastened to the sides of the penis by cotton film and collodion. As a final dressing after the application of iodoform collodion, the penis may be covered in by a few turns of a very narrow gauze bandage.

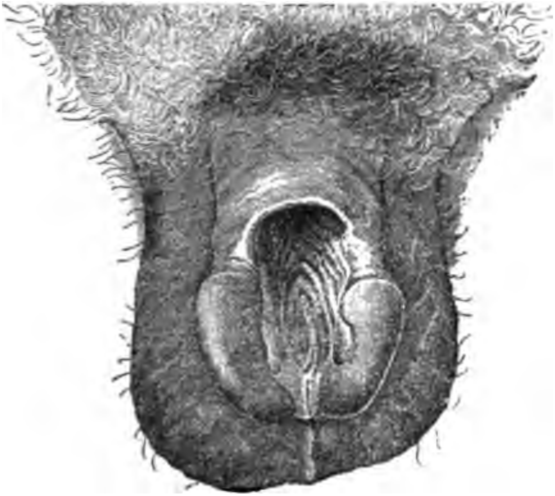
The first stage of this operation should be undertaken at about the fourth year, the next stage six to ten months later. The final stage may be reserved till puberty; though most surgeons prefer to perform it as soon as it is evident that the results of the earlier operative interference are satisfactory.

Wood's operation for hypospadias is applicable particularly when the defect is in the anterior half of the urethra. Two lateral flaps are made from the skin of the under surface of the penis, along the urethral groove well back to the opening. Upon being turned so that the skin surface is toward the new canal, their edges are united by a fine catgut suture. The redundant dorsal prepuce is then button-holed by a transverse incision close to the coronal groove and the glans passed through. The transposed hood of dorsal prepuce is separated into two layers at its cut edge, opened and spread out over the new surface of the reversed urethral flaps, and united to the cut edges of the under surface of the penis by fine closely applied sutures. If the preputial flap is insufficient to cover the raw surface entirely, a small flap from the scrotum may be made to supply the deficiency.

Becks operation is particularly serviceable after the fifth year when the hypostadic opening is close to the glans. The procedure is based on the fact that the penile part of the urethra is very extensible, easily separated from its surroundings, and so well vascularized that its nutrition is not threatened by such separation.

A transverse incision is made on the lower surface of the penis at the base of the glans, and a longitudinal incision extended from its center as far back as necessary. The urethra is then exposed and freed from its attachments for a sufficient distance. A double-edged, narrow bistoury is passed longitudinally through the glans and brought out at the transverse incision. A pair of fine forceps is passed backward through this canal, and the end of the urethra grasped by them is drawn through the glans and sewed securely to the mucous membrane around the edges of the incision. The longitudinal incision, which generally extends to the scrotum, is then sutured with separate catgut stitches, each stitch catching the urethra superficially but not puncturing it. The transverse incision is then sutured and the wounds dressed. An antiseptic placed over the end of the penis is changed at each act of urination.

Fig. 41.

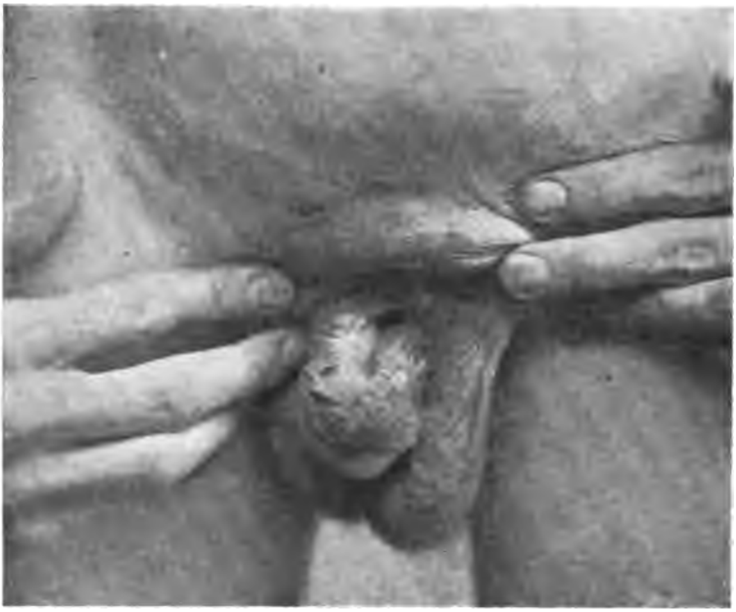


Glandular epispadia. (Kaufmann.)

Epispadia.—In this deformity a portion or all of the roof of the urethra is absent, the canal being represented by a furrow traversing the mid-dorsal aspect of the penis. It is often complicated by exstrophy of the bladder, and is sometimes associated with other malformations, such as urachal fistula, imperforate anus, absence of the prostate, abnormalities of the corpora cavernosa, etc. This anomaly, rare in all its forms, may appear as the glandular form,—*i.e.*, the urethra is complete as far as the glans, opening just behind this expansion of the spongy body (Fig. 41); more often the abnormal opening is just in front of the pubic symphysis (Fig. 42), or rather in the normal position of this junction, since in many of these cases the pubic rami do not extend to the middle line.

In these cases the penis is short, broad, curved upward, at times twisted; the prepuce is redundant below, and there is a projecting belly-fold above, against which the dorsum of the glans is apposed. On drawing this down the urethral furrow is seen lined with thin mucous membrane and passing backward to the urethral orifice deeply sunken in the pubic region. This orifice is usually large, often admitting an examining finger without difficulty. In case the posterior urethra is involved, there is exstrophy of the bladder, ordinarily with absence of the pubic symphysis.

Fig. 42.



Usual form of epispadia.

Epispadia is often attended with incontinence of urine, though when the posterior urethra is perfectly formed and there is no separation of the pubic bones micturition may be accomplished normally. Except in cases of marked curvation of the penis, erection and intromission are possible.

Treatment.—The treatment of epispadia is either palliative—*i.e.*, the adaptation of a properly fitting portable urinal (see Exstrophy, page 394)—or radical,—*i.e.*, by operative measures.

Operation.—The penis is straightened by one or more deep transverse cuts across the dorsum, sutured so that the ends of the incision are approximated, as in hypospadia. After a sufficient lapse of time (see above as to hypospadia) the edges of the urethral fissure are freshened and approximated over a catheter. In this case, however, the catheter is passed into the bladder through the epispadic opening, and is kept in place till the apposed freshened surfaces have united. The redundant prepuce is button-holed to an extent sufficient to admit the glans penis; the latter is then passed through this opening, the preputial layers are split, and the resulting raw surface is apposed to the dorsal coronal surface of the glans penis and the anterior border of the newly formed penile urethra, which are denuded to a sufficient extent to receive this large graft. Thus the redundant prepuce is disposed of, and the penile urethra and the glandular urethra are covered with skin.

Finally, the borders of the opening remaining between the original urethra and the part newly formed are freshened and approximated by interrupted sutures.

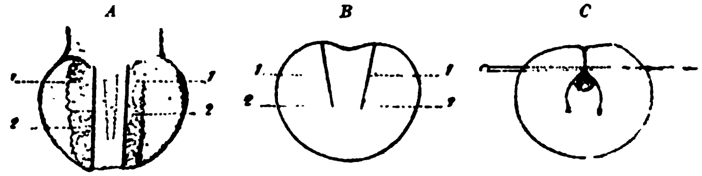
Cantwell's operation is preceded by the insertion of a permanent perineal drain. Beginning at the opening in the bladder, incisions are carried on each side of the penis at the junction of the urethral groove and skin to the glans penis, where they are joined by a transvere cut. The tissue between the incisions is dissected back almost to the bladder-wall, and the flap thus formed is converted into a tube by suturing its edges over a catheter with fine catgut. The corpora cavernosa are then separated throughout their whole length and the glans is either incised or tunnelled. The new urethra is buried between the cavernous bodies and the raw surface is covered by skin suture. If the urethra is too short, a pedunculated flap may be taken from the prepuce, converted into a tube, and drawn through the tunnelled glans, being then united to the distal end of the urethra already formed. The perineal drain is removed in about ten days.

The Thiersch method is still a favorite one, and gives excellent results. Thiersch states that by his method a new urethra is formed which corresponds closely with the normal channel in calibre, function, and position. (Fig. 43.)

There are three distinct periods of the operation.

The first period is devoted to the formation of a perineal fistula. This is readily done by inserting into the bladder a curved forceps. The end of the latter is pressed downward and forward into the perineum and cut upon, care being taken not to injure the rectum. This can be guarded against by passing a finger of the left hand into the anus while the perineal cut is being made. The bladder having been thus opened, a Guyon self-retaining rubber catheter is introduced. If there has been excoriation of skin from leaking and decomposition of urine, it is well to postpone the further steps of the operation until thorough cleansing of the parts and the application of astringent and mildly antiseptic dusting powders have subdued all irritation. This perineal fistula, by diverting the urine from the seat of subsequent operations, enables the surgeon to avoid the dangers and delays incident to suppuration, which almost inevitably occurs when the urine is allowed to escape in its natural course.

FIG. 43.

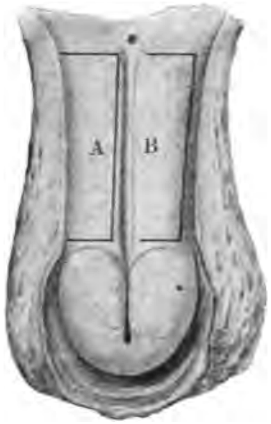


Formation of glandular urethra.—*A.* 1-1, 2-2, freshened surface on each side of the penile furrow. *B.* Cross-section of glans, showing depth and direction of incisions 1-1 and 2-2. *C.* Glandular urethra formed. (Thiersch.)

The second step of the operation consists in the formation of a glandular urethra. To the right and left of the glandular furrow, parallel with the latter, running the whole length of the glans, and in depth equalling three-fourths of its thickness, there are made incisions converging to such an extent that were they continued to the lower surface of the glans they would meet. (Fig. 43.) By these cuts there are formed two lateral flaps and a middle wedge-shaped piece of glandular tissue, the broad base of the latter looking upward and being covered with epidermis. Along the outer border of each incision there is removed a strip of the glandular covering, so that when these lateral flaps are brought together fresh surfaces of sufficient breadth to assure firm union will be apposed. These lateral flaps are approximated over the middle wedge and united by two or three harelip pin sutures. The canal thus formed is more deeply placed at its orifice than in the region of the corona, though this is of minor consequence. Obliteration of this canal is impossible, since the epithelial covering of the middle wedge prevents it.

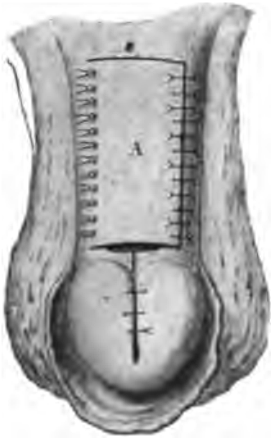
The next step of the operation consists in transforming the penile furrow into a canal. Close to the right border of the furrow there is made a longitudinal incision dividing the skin and the subcutaneous tissues the entire length of the furrow. (Fig. 44.) From either end of this incision a transverse cut is made running outward, thus outlining a long quadrilateral flap. This is dissected up with as much subcutaneous tissue as possible, especially near the base of the flap.

Fig. 44.

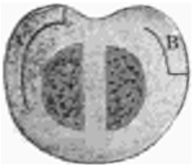


Outlining of flaps to form penile urethra.—A, flap dissected outward; B, flap dissected inward.

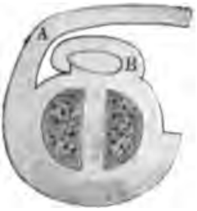
Fig. 45.



A. Flaps folded over and held in position by sutures.—Long flap drawn to the left side of the penis; stitches holding the short inner flap in position.



Cross-section of same, showing the direction in which the flaps are dissected.



Cross-section of same.

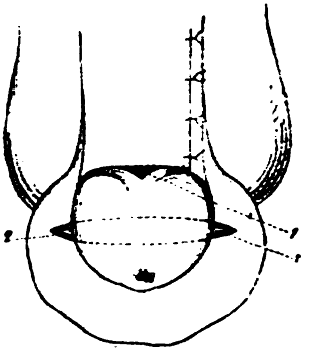
A similar long incision is made to the left of the furrow, about two-fifths of an inch from its edge. From each end of this incision a transverse cut is carried inward as far as the edge of the furrow. This flap is also dissected up with as much subcutaneous tissue as possible. It is then turned over exactly as one turns the leaf of a book from right to left, so that its epithelial surface forms the roof of the furrow, while its wound surface is turned outward. If the flap is sufficiently wide to cover in the furrow entirely without undue tension, three or four threads with a needle on each end are passed through its free border. The first flap is now drawn directly over this flap, which has been turned over, thus approximating the two fresh surfaces of the flaps and covering the whole with skin. (Fig. 45.) Before suturing this flap in position the needles attached to the sutures passing through the free border of the reflected flap are passed from within outward through the base of the first flap, each stitch including a very narrow bridge of the skin. These sutures are tied down, the first flap while they are inserted and secured being held with exactly the same tension as is necessary for its final suture. Finally the superficial flap is secured by suture to the skin border from which the reflected flap was turned in.

The canal thus formed is closed with skin both within and without, and is of the right calibre. There is no danger of the flaps sloughing provided they have been left sufficiently thick at their base and have been dissected so freely that there is no tension. Should there be dangerous tension, two long incisions are made to the right and left of the lower mid-line of the penis. These are carried down to the fibrous sheath, and are allowed to heal by granulation.

The next step of the operation consists in the union of the glandular and penile urethras. This is made at the expense of the foreskin. The transverse defect existing between the penile and the glandular urethra is first completely and widely freshened. The foreskin is stretched out and an oblique incision is made entirely through it, forming an opening sufficiently large to allow the glans to slip through. (Fig. 46.) The lower half of the foreskin is thus by its raw surface closely applied to the corona. The foreskin having been brought up in place, one of its layers is carefully sutured to the upper border (formed by the new urethral roof) of the defect, and the other border is secured to the freshened corona glandis. (Fig. 47.) It is necessary carefully to separate the two layers of the foreskin, otherwise they will unite to each other instead of to the freshened surfaces. This portion of the operation also has cosmetic virtues, since it gives the penis a more normal appearance.

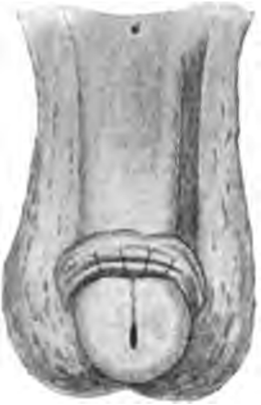
The final step of the operation consists in closing the posterior defect. This is accomplished by means of two flaps cut from the surrounding belly walls. The first flap is formed from the left side. It is in the shape of an equilateral triangle, with its base corresponding to the left half of the skin surface lying immediately above and to the left of the roof of the urethral orifice. (Fig. 48.) The corner of this flap is folded downward and inward so that its skin surface covers in the defect. Its lower free border is sutured to the freshened upper border of the new roof formed by transplantation of the penile skin. The second flap approximates the form of a quadrilateral with its attached base in the region of the right inguinal canal. This flap is drawn downward and inward so that its freshened surface covers in the fresh surface of the first flap. It is secured in this position by sutures, including both the lower flap and the bor-

FIG. 46.



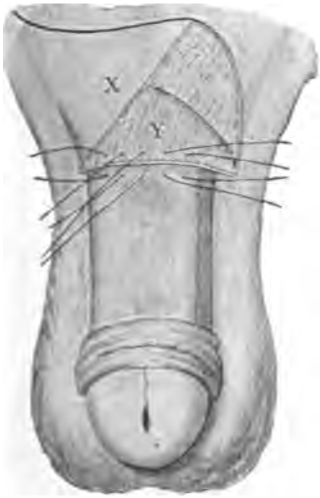
1. Transverse defect between penile and glandular urethras; 2, 3, oblique incision through foreskin. (Thiersch.)

FIG. 47.



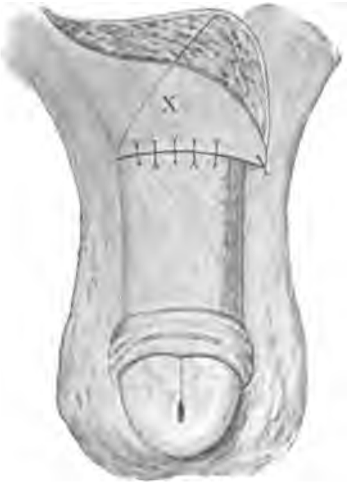
Foreskin brought up behind the glans, and line of sutures uniting freshened edges of transverse defect to foreskin.

FIG. 48.



Closing posterior defect.—Formation of flaps X and Y; suture of first flap.

FIG. 49.



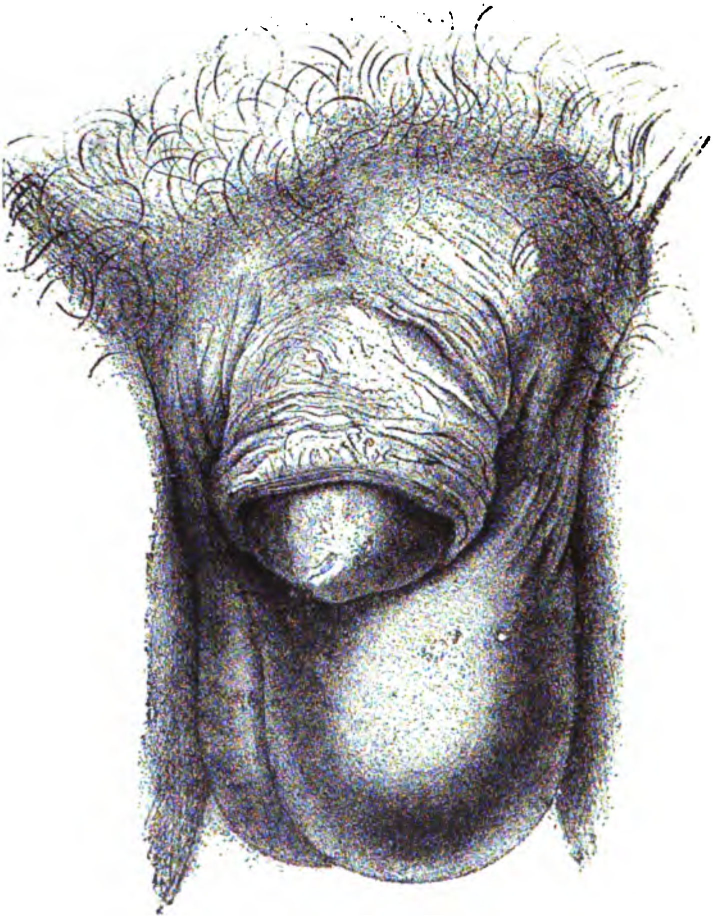
Suture of second flap.

ders of the skin incision required for the preparation of the triangular flap. (Fig. 49.) The raw surface left after this transplantation is allowed to heal by granulation.

Healing of the perineal fistula completes the operation. This is readily accomplished by removing the tube.

It cannot be expected that this operation will be at once and completely successful. Fistulæ often form; portions of the flaps often fail to unite. The time of cure is, therefore, apt to be protracted.

Fig. 50.



Cured epispadia. (Thiersch.)

In Thiersch's own case (Fig. 50) it required about one and a half years. He holds that ordinarily it should be accomplished in three or four months. He advises that the various steps of the operation be performed in the order given, allowing fourteen days for the formation of the perineal fistula, fourteen days for forming the glandular urethra, twenty-one days for closure of the perineal furrow, fourteen days for transplantation of the foreskin, and, finally, for the closure of the urethra and the subsequent operations which may be necessary, forty-two days.

Rosenburg, after perineal drainage, denudes the borders of the penile furrow as far back as the abdominal wall, from which he excises two quadrilateral strips of skin corresponding in dimensions with the denuded penile areas. The penis is turned up against the abdominal wall and the raw surfaces are held in apposition by suture. In two weeks the penis is dissected from its abdominal position, a portion of skin being removed with it of sufficient size to be turned in and cover the raw surface representing the new urethral roof.

INJURIES OF THE URETHRA.

The urethra may be wounded or subcutaneously ruptured.

Wounds of the urethra are surgical or accidental. Accidental wounds are rare.

INCISED WOUNDS of the urethra, if longitudinal, heal readily and often without subsequent stricture, even though no sutures are applied. When such injuries are inflicted from without, either intentionally by the surgeon, as in the case of external urethrotomy, or as a result of accident, provided the urethra is healthy and the urine sterile, the wound may be sutured, the urethra being first closed by fine buried catgut sutures, not including the epithelial coat, and the skin, subcutaneous tissues, and spongy body being approximated by a second row of interrupted fine silkworm-gut sutures. Continuous catheterization is kept up from two to five days. When the urethra is suppurating the wound should be allowed to heal by granulation. When the urethral wound is not extensive it is not necessary to employ stitches.

When the urethra is incised transversely there is free bleeding, and, if the canal is cut completely across, the proximal end retracts. Healing by granulation always implies a degree of coarctation depending on the extent of the wound. When the urethra is completely divided, the proximal end may be found by posterior catheterization through a suprapubic opening in case it has retracted so that it is not easily secured in the wound. The divided urethral ends must then be held in neat apposition by interrupted catgut sutures placed one-eighth of an inch apart and not penetrating the epithelial layer. When the continuity of the roof of the urethra is thus restored by three or four sutures, a soft catheter is passed into the bladder, the urethral suture is completed, the external wound is closed, and the catheter is tied in place; as in all cases of continuous catheterization, the bladder and urethra receive frequent antiseptic irrigations.

Always after the healing of transverse wounds of the urethra involving more than one-third of the circumference of the canal a sound should be passed at first once a week, then at longer intervals, till there is no marked tendency to stricture formation.

LACERATED AND CONTUSED WOUNDS of the urethra are cleansed, opened so that drainage both of urine and of wound discharges is freely provided for, and allowed to heal by granulation, continuous catheterization being maintained till the urethral defect is entirely closed in. Patients after these injuries must be instructed in the use of the sound, since it will be necessary for this instrument to be passed at regular intervals for probably the rest of their lives.

Whenever, because of the limited extent of a lacerated and contused wound, there is sufficient tissue left, after trimming away that which is devitalized, to allow of urethral suture, this procedure should always be adopted, since thus subsequent stricture may be lessened.

PUNCTURED WOUNDS, when from without, are not attended by extravasation, and require simply the application of wet antiseptic and evaporating lotions, as, for instance, lead water and alcohol, to limit inflammatory reaction. When the urine is sterile no intra-urethral treatment is required. When it is infected, and particularly when the urethra is inflamed, as in acute or chronic gonorrhœa, irrigation with protargol solution 1 to 2000, or bichloride 1 to 20,000, is indicated.

When the punctured wound is from within, as in the formation of a false passage, free bleeding and the detection of the point of the instrument outside the urethra by external or rectal palpation show the nature of the injury. Usually such wounds heal spontaneously without becoming infected even though infection of the urethra has existed previously. Exceptionally they suppurate, forming abscesses.

The *treatment* of such wounds consists in refraining from further instrumentation, making the urine slightly antiseptic by appropriate medication, and using mild antiseptic irrigation, 1 to 2000 protargol or 1 to 6000 permanganate, under low pressure (elevation of reservoir, three feet). In case of local and general symptoms pointing to suppuration, drainage must be provided for by external incision.

Rupture of the Urethra.—Subcutaneous rupture of the urethra when seen in the penile portion of the canal is usually the result of the breaking of chordee, fracture of the penis, or twisting, wrenching.

or pinching force applied to the erect organ. The penis is so movable that it usually escapes the crushing effect of force applied in the form of blows and kicks. Subcutaneous rupture is commonly observed in the perineal urethra. Kaufmann, as the result of a statistical study of over two hundred cases, gives as the form of injury, falling astride eighty per cent., perineal blows twelve per cent., being run over by vehicles four per cent., being unseated upon the pommel of the saddle four per cent.

The mechanism of the perineal rupture depends upon the shape of the vulnerating body and the direction in which the force is applied. Where there is a fall astride upon a narrow body, as, for instance, the edge of a half-inch plank, this is forced upward between the ischio-pubic rami, usually a little to one side, tears the triangular ligament, and crushes the urethra against the ischio-pubic ramus. When the vulnerating body is larger, as, for instance, the square toe of a boot, the urethra is driven directly upward against the lower or anterior surface of the pubis, the lower portion of the urethra rupturing first. Together with the urethral rupture there are always contusion of the bulb, of the perineal tissues, and often of the attachment of the cavernous bodies.

The seat of contusion and laceration of the urethra is usually in the bulbous part of the urethra, except when there is fracture of the pelvis or disjunction, temporary or permanent, of the pubic symphysis, in which cases the membranous urethra is involved.

The rupture may be partial or complete. In the mildest cases the spongy tissue is the only part involved. There results in consequence a temporary narrowing or blocking of the urethra, due to circumscribed blood effusion into the loose erectile tissue of the spongy body. In more severe cases both the spongy body and the mucous and submucous layers of the urethra are crushed and torn. In the most severe cases not only is the urethra with the surrounding spongy body injured, but likewise the fibrous investment of the latter, thus making a direct communication from the floor of the urethra to the loose cellular tissue of the scrotum and the peritoneum.

The rupture may involve the entire lumen of the tube, or, as is more frequently the case, may include only its lower and lateral wall. In case of complete transverse laceration there is always marked retraction, leaving a space from one-half to three-fourths of an inch, at first filled with blood-clot, later converted into an abscess.

Symptoms.—The symptoms of laceration of the urethra are urethral hemorrhage, the immediate formation of a circumscribed tumor at the seat of injury, retention of urine, and pain.

The amount of bleeding from the urethra cannot be regarded as an index of the severity of the lesion. Blood escaping from the meatus after trauma always indicates laceration of the mucous membrane at least, and even though but a small quantity is lost, as in the breaking of a chordee or from a false movement in coitus, there is liable to result periurethral inflammation, with the ultimate formation of an unyielding stricture.

The immediate perineal swelling is due to extravasated blood. Skin discoloration appears after one or two days. When extravasation of infected urine takes place there will be the symptoms of deep cellulitis, involving the scrotum and penis and extending upward over the abdomen. Retention of urine is observed in a large majority of cases. When there is total rupture this retention is due to separation of the urethral ends and the interposition between them of masses of coagulated blood. In cases of partial rupture, obstruction of the tube from blood-clot and urethral spasm incident to the injury may be operative in causing retention. If retention is not at first noticed, but develops subsequently, it is due to obstruction caused by inflammatory swelling.

In rupture of the posterior urethra there may be neither bleeding from the meatus nor any sign of perineal tumor. When urinary extravasation takes place it occurs in the deep tissues, and produces no symptoms until cellulitis has been set up. In cases of this character there is retention of urine; obstruction is not felt on introduction of the catheter until it has penetrated to the depth of six inches and is passing through the subpubic urethra. Then either its further progress is arrested, or if it passes into the bladder and remains unobstructed by blood-clot there flows urine mixed with blood. In ruptures of the anterior urethra, when the bladder is once reached by instrumentation, the urine is clear.

The consequences of rupture of the urethra are urinary extravasation, septic infection, and later traumatic stricture. At each act of micturition a part or the whole of the urine is liable to be forced into the periurethral cellular tissue, extending at once into the scrotum or the perineum if the fibrous envelope of the bulb has been torn. This urine, even if originally sterile, shortly becomes infected, sets up cellulitis, and occasions sloughing and gangrene, which, unless the case is promptly attended to, result in death. In consequence of the nature of the injury—*i.e.*, a crush—there is, when the canal is not torn completely across, more or less sloughing, with subsequent cicatricial contraction, and often a most obstinate fistula. When the ruptured ends of the urethra have not been apposed, there is formed between them a granulating sinus, whose walls exhibit all the vices of cicatricial tissue. Because of its common association with fractured pelvis, the prognosis of rupture of the membranous urethra is guarded.

Diagnosis.—The history of the injury, the perineal tumor of sudden formation, blood from the meatus, either flowing spontaneously or induced to appear by pressure on the perineal tumor, are sufficient to justify an absolute diagnosis of rupture of the anterior urethra. Bleeding is in itself diagnostic when it follows traumatism, and in the absence of perineal tumor and marked dysuria denotes simply a slight tear of the mucous membrane without involvement of the periurethral tissues. A rapidly formed perineal tumor associated with dysuria or retention usually signifies an extensive laceration. The seat of rupture is indicated by local tenderness and often by the signs of external violence. The history of the injury is also of importance in determining this point. Thus, when there has been a fall astride of a comparatively wide surface, such as a joist or the pommel of a saddle, the bulbous urethra is almost certainly involved. If the injury has resulted from a fall on the edge of a board, for instance, it is probable that the membranous urethra is ruptured. In cases of pelvic fracture or disjunction the diagnosis is sometimes extremely difficult. There is little deformity, and crepitus may not be elicited. There may be bleeding from the meatus, but usually the spasm of the compressor urethræ muscle causes the blood to flow back into the bladder. The history of the injury,—commonly, in case of fracture, a crushing force applied to the two sides of the pelvis,—the detection of crepitus by rectal examination, the almost invariable development of urinary retention, and the difficulty in catheterization or the drawing off from the bladder of blood with the urine, would point to rupture of the membranous urethra.

Treatment.—In the least serious cases—*i.e.*, those characterized by moderate hemorrhage from the meatus, either with or without circumscribed non-progressive tumor-formation in the perineal region, and not complicated by retention—the use of pressure, together with the application of hot antiseptic compresses, the administration of urinary antiseptics by the mouth, rest in bed, free purgation, and mild antiseptic irrigation of the urethra, may bring about cure. In the simplest form of urethral rupture the catheter should not be used unless dysuria or retention makes it necessary. Under these circumstances a large, soft, elbowed gum instrument should be employed; and it should be introduced and withdrawn with a solution of protargol (1 to 2000) flowing through it from a fountain syringe elevated not more than two feet above the bladder level.

In case symptoms of deep inflammation develop,—*i. e.*, increased swelling and tenderness, with constitutional involvement,—recourse must at once be had to more radical means.

In the severer cases of rupture, characterized by decided perineal tumor, urethral bleeding, and urinary retention, if the soft gum or more rigid elbowed catheter can be passed into the bladder and there flows from it clear urine, this instrument may be allowed to remain in place for three to five days (for details of continuous catheterization, see page 312), the perineal blood effused being limited by the immediate application of cold and pressure. If the soft catheter cannot be made to enter the bladder, immediate perineal section is indicated. Advisable when there is retention or marked dysuria and the catheter cannot be passed readily, this operation becomes absolutely imperative when œdematous swelling of the perineum and scrotum and symptoms of constitutional depression make it apparent that urinary extravasation and consequent cellulitis have occurred.

The operation is conducted in accordance with the principles laid down on page 251. A catheter or staff is passed to the seat of rupture, and the perineum is opened upon this in the middle line. This can be done under eucaine anæsthesia. The incision should be free. On opening the deep layer of the superficial fascia there is found a cavity filled with clots, with, in recent cases, bleeding still persisting. Guided by the catheter, the urethra is readily identified, threads are passed through its two sides to act as retractors, and, in case the canal is not completely torn across, the catheter is readily passed into the bladder. Bleeding points are then secured by ligature, and the urethral rent is closed, if possible, by interrupted chromicized gut suture, including in its grip as much periurethral tissue as possible. The cavity resulting from the bleeding is closed by buried catgut sutures and the skin is secured by silkworm-gut. The catheter is left in place from four to six days.

If the urethra is completely torn across and the proximal urethral end is not discovered after a brief but careful search, Guyon advises the passage of a sound from the meatus till its extremity is arrested by the posterior wall of the cavity made by the blood extravasation. The left index finger is then passed, palmar side up, to the point pressed upon by the tip of the sound. The latter is slightly withdrawn, and in many cases just above the position occupied by the end of the finger will be found the proximal end. Through it, guided by the finger, may be passed an instrument from the perineum into the bladder. Sudden bimanual pressure on the bladder by the fingers of one hand in the rectum and of the other over the hypogastric region may cause a few drops of urine to exude, and thus show the position of the torn mucous channel, which in recent cases is found to be a movable bleeding cord. When eucaine anæsthesia has been employed, the patient may aid the surgeon by efforts at micturition.

When the case has advanced to abscess-formation and extensive sloughing, or when the rupture has occurred as a complication of pelvic fracture, it may be impossible to find the proximal end of the urethra except by means of retrograde catheterization practised through a suprapubic opening made in the bladder.

The proximal end of the urethra having been found, a soft rubber catheter is passed from the meatus into the bladder, and the ragged or irregular wound edges are trimmed off, and approximated over the catheter by means of chromicized catgut sutures, taking in the periurethral tissues. This suture is made easy by thrusting the proximal end of the urethra downward and forward well into the wound by means of a finger inserted into the rectum. Often union does not take place ; but, even though it fails, less cicatricial tissue is formed than when there has been no attempt at suture. When there is no local infection the whole wound is closed by buried catgut sutures, an antiseptic dressing being held in place either by a T-bandage or by a crossed of the perineum. Continuous catheterization is not employed for more than six days. (See page 252.) After the catheter is withdrawn a full-sized sound is passed every three, four, or five days for some weeks, and is afterwards continued at longer intervals for months or years.

Even when operation is delayed, and infiltration and septic inflammation have already occurred, approximation of the torn urethral ends should be attempted by suture. There should, however, be no effort to close the infected cavity, this being cleansed and packed with sterile or iodoform gauze and allowed to granulate from the bottom.

FOREIGN BODIES IN THE URETHRA.

Foreign bodies in the urethra are either introduced from without or pass forward from the bladder, in the latter case appearing as urinary calculi or fragments of neoplasm. The bodies introduced from without are usually segments of catheter, the instruments employed being old and breaking during introduction or withdrawal. In the case of social perverts almost any object, if sufficiently small, may be passed into the urethra. Exceptionally, animal parasites may be found.

The behavior of a foreign body lying completely within the urethra depends upon its shape and size. When it is smooth and rounded, as, for instance, in the case of a broken fragment of catheter, a small wax candle, or a piece of lead-pencil, it nearly always exhibits a tendency to pass back into the bladder. This occurs in about thirty per cent. of all cases, and is due to the constant handling of the parts by the patient, to the frequent erections reflexly excited by the presence of the foreign body, followed during subsidence by contraction of the urethra in the direction of its length, and to the action of the longitudinal unstriped muscular fibres of the urethra. A smooth, not too large foreign body may pass back into the bladder in less than a day.

Should the foreign body remain in the urethra, the navicular fossa, the bulb, and the prostatic urethra are its seats of preference, these portions of the canal representing the regions of greatest dilatation.

Symptoms.—Localized pain, interference with micturition, and inflammatory phenomena are the characteristic symptoms of foreign body in the urethra.

The pain is usually severe, especially when the foreign body is irregular in shape. When a catheter is broken off in a urethra which has long been tolerant of instrumentation, there may be no suffering, especially if the broken end is lodged in the membranous or prostatic portion. Foreign bodies located in the posterior urethra, particularly if irregular in shape, with sharp corners or angles, cause pain characteristic of posterior urethritis,—*i.e.*, there is a deep ache felt in the perineum, with itching, burning, or a sense of weight and dragging in the rectum, and shooting or persistent pain in the hypogastric region, about the sacro-iliac articulation, and radiating down the inner surfaces of the thighs.

Interference with micturition depends mainly upon the size and position of the foreign body and upon the amount of inflammatory reaction its presence sets up. Immediate retention is rare. There are always increased frequency of urination and lessening in the force and volume of the stream. Unless the body is removed or passes back into the bladder, micturition becomes progressively more difficult and painful because of swelling due to inflammation.

Inflammatory phenomena are quickly developed. When the body is lodged in the anterior urethra, there is shortly a blood-stained mucopurulent discharge, with redness, heat, and swelling of the penis. This is commonly accompanied by fever. When the body is lodged in the posterior urethra, increased tenderness on perineal and rectal palpation, the appearance of constitutional symptoms, and often the development of cystitis or epididymitis, show extension of inflammation.

Diagnosis.—The history of the case is usually sufficient to establish the diagnosis. In the case of a sexual pervert, a reliable history may be entirely wanting. The symptoms in themselves are merely suggestive, since pain, frequent and obstructed urination, and urethritis may develop from a variety of causes.

Direct examination, even in the absence of history, nearly always makes the nature of the case plain. Palpation will usually show the size, shape, and seat of the body if it is located in the anterior urethra. Bimanual palpation is employed when the foreign body is farther back, the finger of one hand being passed into the rectum, whilst with the other counter-pressure is exerted first in the perineum, then in the suprapubic region.

Providing the urethra is not strictured, the urethroscope can always be depended upon to bring the foreign body into view. This instrument also enables the surgeon to determine the amount of impaction, and to choose and apply his extracting instruments so that they shall act to the greatest mechanical advantage. In introducing the urethroscopic tubes, if the position of the foreign body has been previously determined, pressure behind it should be made, lest by manipulation it should be forced back into the bladder.

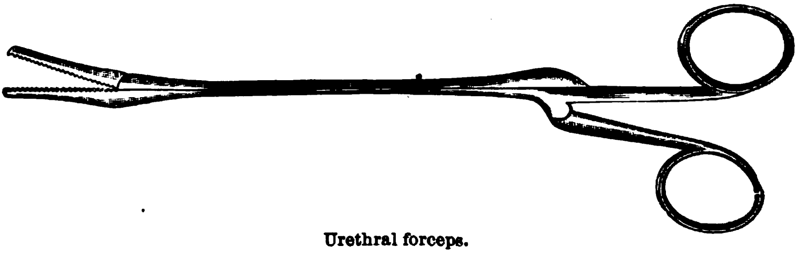
The introduction of a metal sound about No. 18 F. will, in the absence of the urethroscope, show the position of the foreign body by the resistance which is encountered when it is reached, and, in case the body be hard, by the click which is heard when it is touched. In this manipulation, pressure from behind should be employed to prevent the body from being pushed into the bladder.

A foreign body introduced into the urethra, if neither expelled nor extracted, may pass back into the bladder or may remain, becoming incrusted with urinary salts and causing ulceration which is prone to extend through the urethral wall, forming a suppurating cavity which opening externally may result in an obstinate urethral fistula. It is in the prostatic urethra that foreign bodies are most apt to remain indefinitely, causing slow ulceration, and becoming so embedded in inflammatory material that their detection may be extremely difficult.

A foreign body once lodged within the urethra if not expelled with the first subsequent act of micturition is not likely to be expelled afterwards. Inflammatory swelling fixes it more firmly, and from reflex irritation causing frequent urination the stream loses in volume and force. There are, however, exceptions to this rule.

Treatment.—The simplest method of ridding the urethra of the foreign body, and one which may succeed providing the case be seen immediately after its introduction, is to direct the patient to urinate forcibly. When the stream is fairly started the lips of the meatus are pressed together for four or five seconds and are then suddenly released. This failing, recourse should be had at once to forceps. (Fig. 51.) The introduction of these is preceded by examination through the urethroscope, thus enabling the surgeon to judge how best to apply them, or in case the foreign body be a pin or a splinter it may be removed directly through an endoscopic tube. In grasping the body with forceps it should be pressed forward from behind by perineal or rectal pressure, thus avoiding the danger of pushing it back into the bladder. If the forceps fail to grasp the body, or if because of its angular shape withdrawal requires so much traction that extensive laceration of the urethra is liable to result, further attempts at extraction should be abandoned, the patient being put in the lithotomy position and the body being removed through a perineal or penile incision carried down to it in the middle line.

FIG. 51.



Urethral forceps.

The resulting wound is closed by a buried catgut suture including the urethra and its fibrous investment, but not the epithelial layer of the mucous membrane, and skin stitches of silkworm-gut or horse-hair.

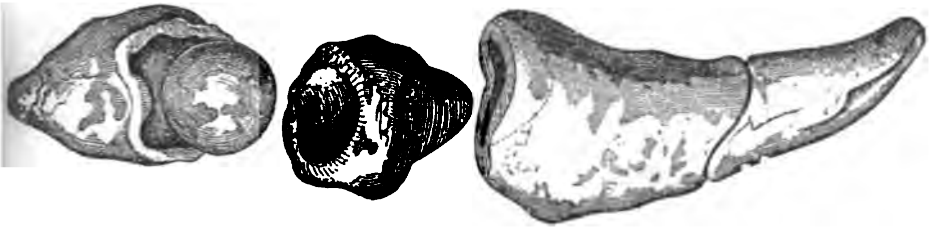
Special manipulations may be serviceable in certain cases. Thus, should the foreign body be a gum catheter, a lead-pencil, or other non-metallic body, and should the forceps fail to grasp it, ordinary round-pointed sewing needles may be driven into it through the urethra, and by means of these, the elasticity of the urethral walls allowing some play to the needles, the foreign body gradually may be brought to the meatus.

The evacuating tubes employed for lithotomy, or, better still, a large, straight cylinder, open at the end and attached to the Bigelow evacuator, may prove efficient when forceps fail. The tube is carried down to the foreign body, the urethra is temporarily obliterated behind the latter by firm pressure, its anterior part is then distended by sudden pressure upon the aspirating bag, and this pressure is immediately relaxed. The foreign body may thus be sucked into the evacuating tube. A pin, nearly always introduced head first, may be extracted by driving its point through the urethral walls, thus rendering it easy to seize the head in the forceps within the urethra.

URETHRAL CALCULI.

Exceptionally calculi are formed within the urethra, in which case they are always phosphatic. Usually they come from the kidney or the bladder, and, though apparently phosphatic from incrustation, show a uric acid nucleus. They are most frequently observed in infancy and past middle age. Their common seat is in the bulbo-membranous and prostatic regions and in the navicular fossa. Calculi rarely form spontaneously in the urethra behind a stricture, the stagnation not being sufficient to allow of this. It is in urethral pouches or diverticula, or in the suppurating blind pouches resulting from glandular inflammation complicating urethritis, that calculous formation most frequently takes place.

FIG. 52.



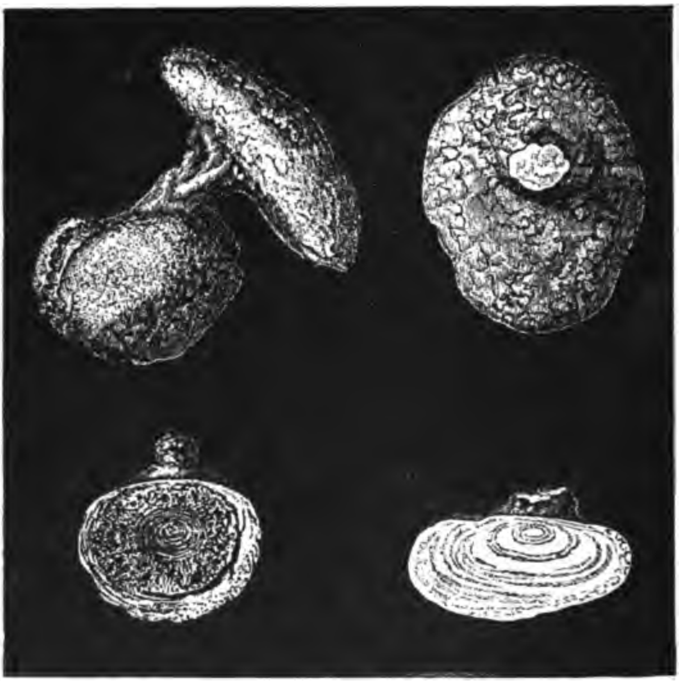
Urethral calculi showing segmentation.

The direction of growth from incrustation of the calculi found behind strictures or in physiologically dilated parts of the urethra is dependent upon the pressure exerted by the urethral walls. The layers of lime salt are so deposited as a result of this pressure that the growth is backward. As the calculi increase in length they are liable to be segmented by fracture: hence in many cases several calculi are found placed in line and articulating with one another. (Fig. 52.) Prostatic calculi growing backward encounter much peripheral resistance in the region of the vesical neck. Having passed this, there is nothing to prevent their extension in all directions. Hence these calculi often exhibit the appearance of two nodules connected by a narrow bar. (Fig. 53.)

The growing calculus may cause great dilatation of the infantile urethra. In the adult there is more commonly ulceration, the calculus escaping into the periurethral tissues, and sometimes in this position attaining great size before it reaches the surfaces or causes inflammation or urinary infiltration sufficiently serious to require operation. Usually the ulcerating cavities in which these calculi lie open externally. In about twenty per cent. of cases urinary infiltration occurs. A calculus which has thus left the urethra, and which lies in a cavity which communicates with the latter only by a narrow opening, cannot be detected by the passage of urethral instruments.

Symptoms—Calculi which form in the urethra would give no other symptoms than those due to the inflammation and gradually increasing obstruction,—*i.e.*, urethral discharge and increased frequency of urination followed by dysuria. Impacted calculi from above occur in the persons of those who have passed gravel or have had attacks of nephritic colic. In children these symptoms are generally absent. The lodgement of the stone occurs during urination. There is sudden partial or complete stoppage of the stream, with the sensation of a solid body having lodged in the urethra. This is followed by the symptoms of foreign body in the urethra. (See page 96.)

FIG. 53.



Urethral calculi showing mushroom shape. Cross-sections to exhibit lamination.

Diagnosis.—Given the sudden stoppage of the stream during urination and the sensation of a foreign body having slipped into the urethra, with a precedent lithæmic history, the diagnosis is reasonably certain. It is further confirmed by palpation of the urethra, which may show a hard body, but more commonly elicits only localized tenderness, and by the use of the urethroscope, which in the absence of stricture makes the diagnosis absolutely certain, and also shows the seat of lodgement. In the absence of the urethroscope the soft woven catheter or bougie should be employed; this in striking the stone produces a rough grating sensation. When there is stricture the small metal sound is passed, the click then showing the position and nature of the obstruction, or, this failing, rectal examination may enable the stone to be felt lying between the finger and the sound. Stones lying in diverticula or in periurethral abscesses can usually be detected only by palpation.

The consequences of the impaction of stone in the urethra are not often serious. In cases of stricture with damaged kidneys, complete retention, if not promptly relieved, may have disastrous consequences. The symptoms of impaction are, however, so marked that treatment is promptly instituted: hence there is little chance for grave systemic disturbances. Stones which have ulcerated through the urethral walls always expose the patient to the danger of urinary infiltration.

Treatment.—The treatment is practically the same as that directed in the case of foreign bodies. Immediate removal of the stone is the prominent indication. If it is situated at or near the navicular fossa, meatotomy may be required. The straight, open-ended evacuating tube may render valuable service. Calculi in the prostato-membranous urethra which cannot be grasped readily by the forceps, or which, if grasped and drawn upon, show such resistance that extensive laceration of the urethra is certain to occur, should be pushed into the bladder by a bougie, and then crushed and evacuated. If this pushing back into the bladder requires force, they should be cut down upon and removed, the urethra and wound being closed by buried sutures. Calculi in any part of the urethra which are firmly embedded should be treated in the same way. When the calculus lies behind a stricture, this should be divided by internal urethrotomy if it lies anterior to the bulb, by external urethrotomy if it is bulbo-membranous, the stone then being removed either through the meatus by forceps or through the perineal wound. Stones lying in extra-urethral abscesses should be removed by incision, the opening into the urethra being freshened and closed by catgut sutures and the abscess-cavity being drained by packing.

CHAPTER III.

AFFECTIONS CHARACTERIZED BY URETHRAL DISCHARGE.

In accordance with their etiology, affections characterized by urethral discharge may be classified as follows:

1. Urethrorrhœa. Entirely independent of local lesions.

2. Traumatic urethritis, due to (*a*) Instrumentation, (*b*) Irritating injections, (*c*) External traumatism.

3. Irritative urethritis. (*a*) Ingestive, due to certain drugs and articles of food; (*b*) Diathetic, dependent upon irritating conditions of the urine incident to defective metabolism; gouty, rheumatic, oxaluric, and phosphaturic urethritis; (*c*) Erethismic, due to repeated excessive coitus or prolonged ungratified sexual excitement.

4. Eruptive urethritis occurs during the course of certain acute exanthemata; and as a manifestation of urethral herpes or eczema.

5. Mechanical urethritis, incident to (*a*) Stricture, (*b*) Urethral neoplasms, (*c*) The lodging of urinary calculi, (*d*) Rarely, in children, the entrance of animal parasites.

6. Concomitant urethritis, dependent upon disease of para- and periurethral structures.

7. Infective urethritis.—(*a*) Simple pyogenic, sometimes called irritative or abortive gonorrhœa; (*b*) Gonococcal; (*c*) Syphilitic (primary, secondary, tertiary); (*d*) Chancroidal; (*e*) Tuberculous; (*f*) Typhoidal; (*g*) Influenzal; (*h*) Pneumococcic; (*i*) Diphtheritic.

Urethrorrhœa is due solely to depraved constitutional conditions, and occurs independently of local lesions. It is observed during convalescence from acute, exhausting diseases, such as typhoid fever, scarlet fever, pneumonia, influenza, small-pox, and the like; or in the course of such chronic affections as tuberculosis, cancer, syphilis, advanced nephritis, neurasthenia, anæmia, and other debilitating cachectic conditions. The discharge is dependent upon a relaxed and leaky mucous membrane, and represents an excessive quantity of what is in character a normal secretion. This constitutes the sole symptom, appearing as a colorless viscid material not unlike glycerin. In the urine it forms long shreds.

Diagnosis.—This depends on the history, the general physical examination, and the elimination of other causes, such as catheterization, etc. Microscopic examination of the discharge shows mucus, epithelial cells, a few leucocytes, and a variety of bacteria normally present. Spermatozoa are often found.

Treatment should be entirely constitutional. Incidentally, the urine should be kept unirritating. Local congestion, such as would be caused by sexual excitement, stripping the urethra, and irritating injections must be avoided. Internally, cubebs may be serviceable.

URETHRITIS.

Etiology.—The predisposing cause of urethritis is congestion. This may be incident to constitutional or to local conditions. Both often act together.

The exciting cause of urethritis is microbic infection. This may be existent in a healthy urethra, producing symptoms only when favoring conditions are present; may be introduced from without; may reach the urethra from involved peri- and para-urethral structures or by elimination through the kidneys.

The gonococcus may cause urethritis in the absence of predisposing congestion, though the latter greatly favors its development. This form of infection, much exceeding in frequency and importance all others combined, will be discussed, together with its complications, in a separate section.

Pathology.—This is similar to that of inflammation of other mucous canals, with certain differences incident to the anatomy and physiology of the urethra, its susceptibility to certain varieties of microbic invasion, and its accessibility to local treatment.

The inflammation common to all forms of the acute disease usually begins at or near the meatus and spreads backward. The mucosa of the canal and of its many follicles and lacunæ becomes infiltrated, red, swollen, covered with a mucoid, sanious, or purulent exudate, and soon the epithelium exfoliates. In the milder cases the process is limited to the mucosa, and after a few days or weeks subsides, but exceptionally, the inflammation may persist in the follicles and glands for weeks and months.

In severe cases the infective agents penetrate deeply into the submucous tissue, causing abundant round-cell infiltration, nests of which may be the beginning of periurethral abscess. The process may involve any or all of the structures opening into the urethra, including the upper urinary tract. Lymphangitis and lymphadenitis are common, phlebitis and cellulitis are rare.

Urethroscopic examination of acute diffuse urethritis shows redness, swelling, and exfoliation of the mucous membrane, and mucopurulent exudation.

Symptomatology.—Discharge is the only constant symptom. With this are commonly associated the usual symptoms of inflammation.

Pain may vary from the slightest itching, tickling, or burning sensation at the meatus to constant harassing distress throughout the whole of the canal. It may be referred to the glans, the penis, the deep perineum, or may radiate down the thighs.

Alterations of function vary from slightly frequent urination to annoying urgency, associated with painful vesical and rectal tenesmus. Tenderness is manifested by burning upon urination, aching during erection, or a stabbing, cutting anguish during seminal emission. Persistent, painful erections, with nocturnal pollutions, and chordee, may occur; rarely acute retention develops from reflex or voluntary inhibition of the detrusors or contraction of the sphincter. The objective signs may be absent; they may appear as a simple florid puffiness of the lips of the meatus, or may be conspicuous in the form of inflammatory œdema of the glans, the prepuce, and rarely the subcutaneous tissue with accompanying bubo.

The mechanical disturbances dependent on the swelling vary; there may be slight difficulty in starting the stream, loss of force or diminution of the normal parabolic curve, or dribbling after the act. Swelling or gluing of the lips of the meatus may break or deflect the stream.

The discharge may be manifest only in the urine; it may appear as a slight moisture at the meatus, not noticed unless the intervals between urination are long, or as a drop after stripping the urethra, or during a straining effort at defecation. In acute cases it may appear as a profuse, continuous outpour.

In character, it may be thin and watery, viscid, gelatinous, and stringy, resembling the uncooked white of egg, milk-and-watery in appearance, or may be made up of a thick, yellowish, greenish sanguino-purulent material. It may be noted in the form of crusts where it has dried around the meatus, or as stains on the underclothing. It may be without odor, or extremely foul.

The urine may be cloudy, or quite opaque, depending on the amount of mucus, pus, and blood contained in it; or may exhibit various forms of urethral shreds, from the irregular, short, thick, scaly, tack, or comma-shaped particles, to long, translucent, branching, gelatinous threads.

Traumatic urethritis is usually due to instrumentation or to irritating injections. It may be caused by external traumatism.

Instrumentation always causes more or less traumatism, varying in degree from slight contusion to laceration, puncture, or even rupture of the urethra.

Irritating injections, usually of strong mercuric chloride or carbolic acid or silver nitrate solution, are commonly used to prevent or abort gonorrhœa.

The symptoms are commensurate to the severity of the trauma. Those of the hyperacute type developing immediately and characterized by great pain, rapid swelling, agonizing ardor urinæ, or even retention of urine and a scanty discharge of bloody pus are practically always due to irritating injections. Prolonged or brutal catheterization may cause an intense, frankly purulent inflammation, but of comparatively slow development.

External traumatism can produce urethritis only by first causing a sanguineous effusion into the urethra and in the periurethral tissues as a result of partial or complete rupture of the canal. (See page 91.)

Prognosis.—Urethritis due to irritating injections is at times distressingly persistent, and may lead ultimately to stricture formation. Generally the symptoms disappear promptly.

Treatment.—Instrumentation urethritis may be best avoided by the skilful use of clean instruments, preceded by cleansing the glans and by antiseptic urethral flushings. For the avoidance of the urethritis incident to continuous catheterization, see page 315. During the acute course of an injection urethritis, in addition to rest in bed, hot sitz-baths, diluents by the mouth, and opium suppositories, urethral injections of eucaine and adrenalin together with evaporating lotions applied to the penis may be needed to relieve retention of urine due to inflammatory swelling. Urethritis from external traumatism should be treated by irrigation and sound.

Irritative Urethritis.—Under this heading are included Ingestive, Diathetic, and Erethismic Urethritis.

Ingestive urethritis, characterized by scanty mucoid discharge and slight ardor urinæ, is occasionally noted after the ingestion of such substances as asparagus, rhubarb, turpentine, cubebs, copaiba, cantharides, alcohol, arsenic, and potassium iodide.

Diagnosis.—This is based on the history, and on the absence of other causes for urethral discharge. The symptoms are mild, the duration of the affection brief, and cure results at once upon removal of the cause. Ardor urinæ may be more marked than the inflammatory symptoms would seem to warrant. The discharge which follows the abuse of alcohol is not strictly ingestive, but is usually due to the lighting up of a latent lesion by the irritating condition of the urine.

When the symptoms are unduly prolonged, a search should be made for such lesions.

Diathetic urethritis is dependent upon the irritating urine incident to gout, rheumatism, and the defective metabolism characterized by the habitual appearance of large quantities of oxalates and phosphates in the urine. The relation between the joint manifestations of rheumatism and gout and a slight mucoid urethral discharge has been repeatedly noted; indeed, this discharge has been observed occasionally as a manifestation of so-called retrocedent gout.

Diagnosis.—This must be based on the history. The discharge is associated with general diatetic errors rather than with the ingestion of one or two particular articles of food. Other manifestations of gout or rheumatism are present and the acid urine is highly concentrated. The discharge is mucoid in character, with an abundance of epithelial cells, a few leucocytes, and no gonoccoci. (For the differential diagnosis between gonorrhœal arthritis and gouty or rheumatic urethritis, see page 200.)

Prognosis.—In the absence of complicating gonorrhœal lesions, the urethral catarrh disappears when the constitutional condition is bettered and the urine rendered bland.

Treatment is obvious. Local treatment is not indicated. If, however, the discharge persists, search should be made for localized lesions.

Oxaluria and phosphaturia of themselves rarely cause urethral discharge, though they make quite incurable one which was originally started as a gonorrhœal infection. The persistence of oxalates or phosphates in the urine, accompanied by a mucoid or muco-purulent discharge neither gonococcal nor tubercular in nature and unassociated with urethral stricture, polyp, or other localized lesion, would justify the suspicion that the discharge is dependent on the pathologic condition of the urine.

Erethismic Urethritis.—The discharge resulting from sexual excesses or prolonged ungratified sexual excitement is mucoid in character. It may be exceedingly persistent and usually indicates a urethra especially susceptible to bacterial infection.

Treatment.—This is mainly systemic. Bromides are very exceptionally of service. Hyoscine hydrobromate, grain $\frac{1}{200}$, twice daily, is useful when the discharge is due to prolonged ungratified sexual excitement. For this condition the psychrophore (see page 790) is also serviceable at times. As a rule, local treatment is contraindicated. Exercise, hydrotherapy, occupation, and diet usually suffice to effect a cure.

Eruptive urethritis is often overlooked. It is due to an active hyperæmia, with perhaps an accompanying eruption on the mucous membrane. Doubtless the irritating condition of the urine is a contributing factor. The appearance of slight urethral discharge coincident with the development of the skin or mucous membrane lesions of the fever, the elimination of other sufficient causes for such a discharge, and the disappearance of the latter with the betterment of the constitutional condition, would sufficiently indicate the diagnosis. No local treatment is needed.

HERPETIC URETHRITIS is characterized by a sudden, apparently causeless, slight discharge commonly accompanied by severe neuralgic or burning pain greatly exaggerated during micturition, preceded, followed by, or alternating with external herpetic lesions. There are no gonococci and no involvement of the posterior urethra.

Mechanical Urethritis.—A persistent urethral discharge in a healthy man, whose urine is normal and who leads a fairly healthful life, should always suggest the likelihood of a localized urethral lesion, and should lead to an examination for stricture, ulcer, chronic folliculitis, or urethral polyp. If the discharge has been preceded by a sudden complete or partial stoppage of the urine in the absence of a history of previous urethral inflammation the lodgement of a calculus should be suspected. (See page 100.)

CANCER OF THE URETHRA.—Primary cancer of the urethra occurs in men over fifty years of age who have suffered from chronic urethritis due to stricture. It has been found only in the bulbous and membranous urethra. The growth invariably proceeds towards the penis (Hall), showing no tendency to invade the prostate and the tissues behind the triangular ligament.

Symptoms.—The symptoms, during the early stage of infiltration, are simply those of chronic urethritis; later there may be increasing difficulty in urinating, obstruction to the passage of a catheter, and the formation of rapidly growing infiltrations, which, in the absence of previously existing fistula, soften in one or more spots and rupture, discharging pus, blood, and often very offensive urine. After rupture there is found a comparatively small cavity with hard, irregular walls tending to fungate in places.

Diagnosis.—The diagnosis is based upon the dense infiltration, the progressive and rapid growth, and the removal and microscopical examination of a portion of the tumor. The tendency to bleed and fungate and enlargement of the inguinal lymphatics may possibly prove of diagnostic value.

Cancer of Cowper's gland, which on first examination may suggest primary cancer of the urethra, may be distinguished from the latter by the fact that it has at first a tendency to grow towards the skin and rectum rather than in the direction of the urethra, forming a palpable perineal tumor, which, till it has reached a large size, does not interfere with the passage of a catheter or the free flow of the urine.

In cancer of the urethra the prognosis is absolutely bad, since diagnosis is never made till the disease is well advanced. The duration of life from the time diagnosis is established is rarely more than six months.

Treatment.—Immediate and complete removal of all the diseased parts and of the anatomically associated glands is indicated. Where this is not possible, irrigations, local washings, and morphine in sufficient doses to quiet the patient should be employed.

Concomitant Urethritis.—The peri- and para-urethral affections causative of urethral discharge include: Folliculitis, Cowperitis, Prostatitis, Vasitis, Seminal vesiculitis and Cystitis.

The usual cause of the extra urethral affections which keep up the discharge is gonorrhœa. The history will ordinarily show this to have been present. Before its continuance can be eliminated, it will be necessary to make frequently repeated, painstaking examinations of the urethral discharge, the urine, and the semen for gonococci, microscopically (by the Gram method) and sometimes culturally. When there is no history of gonorrhœa, persistent urethral discharge secondary to infection of the prostate, seminal vesicles, vas, or bladder should lead to careful examination for tuberculosis.

Even though a urethral discharge be found associated with an extra urethral affection, its dependence upon the latter cannot be assumed till all other causative factors, and particularly stricture-formation, have been eliminated, since the usual cause of persistent urethral discharge is stricture.

Specific Urethritis.—Simple purulent inflammation develops after unclean sexual intercourse or unclean instrumentation, particularly in those who from sexual excess, alcoholic indulgence or previous attacks of urethritis are especially vulnerable. The exciting cause may be any form of pyogenic organism.

Symptoms.—These vary greatly. For the mild cases the following is descriptive: The usual cause is coitus with a woman suffering from leucorrhœa. It is characterized by a varying period of incubation, usually very short, at most one or two days, by a reddened, swollen itching meatus, by some pain on urination, and by a milky secretion from the urethra, appearing only when this canal is stripped forward. These symptoms are, of course, identical with those of the earliest stage of acute gonorrhœa, and, except by microscopical examination of the discharge, this form of disease cannot be distinguished from true gonorrhœa. Its course, however, is different. Unless the inflammation is treated by irritants, the symptoms do not increase in severity. Neither ardor urinæ nor chordee develops. The discharge continues for five to ten days and then ceases spontaneously. There are no sequelæ and no complications. The condition is a purely catarrhal one. It is these cases which have obtained for certain remedies a repute for aborting acute gonorrhœa. The disease subsides, under almost any treatment which is not too violent, in a time which is very short as compared with the duration of ordinary gonorrhœa. The attendant is often, and not unnaturally, led to believe that such subsidence is due rather to his treatment than to the spontaneous cessation of the disorder.

The account just given represents the usual course of a simple infectious urethritis. Exceptionally the inflammation is as violent and prolonged as if from gonococcus infection. In strumous and cachectic individuals the discharge may remain slight, but persists for weeks, months, or years, in spite of treatment, and commonly brings about a marked condition of sexual neurasthenia.

GONORRHŒAL URETHRITIS.—This the commonest and most complicated variety of urethritis is considered in a separate section. (See page 113.)

SYPHILITIC URETHRITIS.—A urethral discharge may be due to primary, secondary or tertiary syphilis. Urethral chancre, usually placed within half an inch of the meatus, is practically never recognized as such till a secondary general eruption has clearly indicated the nature of the affection; yet in the absence of a mixed infection the diagnosis should be suggested by a urethral discharge, with an incubation period longer than ten days, induration, inflammatory infiltration of the frænum, the detection of urethral ulcer covered by a grayish pseudo-membrane, and bilateral, non-inflammatory, polyganglionic, inguinal lymphadenitis.

The symptoms of urethral chancre may be limited to a slight painless muco-purulent discharge, spontaneously disappearing in one or two weeks; when such symptoms are detected, especially if they have followed exposure by an interval greater than ten days, the possibility that they have been caused by a urethral chancre should be carefully considered.

Urethral chancre must be distinguished from gonorrhœa, from simple urethritis, from chancroid, and from mucous patches of the urethra.

From gonorrhœa the urethral chancre can be differentiated by a consideration of the contrasted characteristics of each:

Urethral Chancre.	*Gonorrhœa.*
Incubation.—Ten days to three weeks.	*Incubation.*—One to seven days.
Seat.—At or near the meatus.	*Seat.*—The entire anterior urethra. Usually invades the posterior urethra.
Urethroscopic Appearance.—An erosion or ulceration,—a circumscribed area of congested mucous membrane. A healthy urethra behind the lesion.	*Urethroscopic Appearance.*—Marked vascular engorgement of the entire urethral mucous membrane, often with many areas of epithelial exfoliation.
Symptoms.—Slight ardor urinæ, felt only at or near the meatus. Painful erections mostly absent. No pain. Generally marked œdema about the frænum.	*Symptoms.*—Ardor urinæ marked, and felt along the course of the urethra. Painful erections mostly present. Often pain. Sometimes marked preputial œdema.
Discharge.—Scanty, mucous, blood-stained. Contains no gonococci.	*Discharge.*—Profuse, muco-purulent. Usually not blood-stained. Contains gonococci.
Induration.—Distinct, somewhat diffuse, often involves one lip of the meatus.	*Induration.*—Absent. At times a hard, round follicle felt beneath the urethra, which either suppurates, discharging externally, or evacuates its contents into the urethra and quickly subsides.
Sequelæ.—Painless, non-inflammatory enlargement of inguinal lymphatics, followed in six or eight weeks by secondary symptoms. Spontaneous subsidence of local symptoms.	*Sequelæ.*—Lymphatics do not enlarge, or exceptionally one or two become acutely inflamed, and sometimes suppurate.
Sensibility.—The application of a syringe or any mechanical interference occasions pain at or near the meatus.	*Sensibility.*—The use of a long-nozzled syringe or any mechanical interference occasions pain along the course of the urethra.

The diagnosis between urethral chancre and chancroid must be made upon the grounds which enable the surgeon to distinguish between these two lesions when situated upon the surfaces of the genitalia. The absence of a period of incubation, the acute local inflammatory symptoms, the free discharge, and, above all, the punched-out, ragged, non-indurated, spreading ulcer, are fairly characteristic of chancroid, but the meatus chancre is often distinctly chancroidal in type.

The diagnosis of urethral chancre from mucous patches of the urethra is usually made easy by the presence of other manifestations of secondary syphilis and the absence of an indurated ulceration or abrasion. The lesions are not different from those observed on other mucous membranes. The disease is highly contagious.

A persistent mucoid or muco-purulent discharge also characterizes secondary and tertiary syphilitic lesions, which are found in the urethra as areas of congestion, mucous patches, or relapsing gummatous ulcerations. Unless there be a double infection the gonococci will not be found. Secondary lesions in the urethra will be attended by co-existing eruptions on other mucous surfaces and on the skin, with other signs of secondary syphilis. Urethroscopic examination will show areas of non-indurated exfoliation, erosion, or ulceration, usually near the meatus. The inflammatory symptoms are mild as compared to gonorrhœal, herpetic, and eczematous eruptions; and in the pure syphilitic infection there are no symptoms referable to the posterior urethra.

Treatment.—This is that appropriate to the syphilis. Injections are rarely needed.

CHANCROIDAL URETHRITIS begins at the meatus and extends backward. The period of incubation is variable (one to four days or longer). Abundant staphylococci and other pyogenic organisms are found in the purulent, often blood-stained, secretions, but, unless double infection has occurred, no gonococci; not infrequently similar lesions are noted on other parts of the genital organs. Absence of induration is the rule. Inguinal buboes are common.

The subjective symptoms are mild compared with the profuseness of the discharge. In the absence of mixed infection there are no deep-seated complications. Unlike chancre, which may be entirely intra-urethral, the ulceration of chancroid either develops on the lips of the meatus or shortly appears there, making the detection of their presence easy. Urethral chancroids are occasionally followed by fistulæ, and, as a rule, by stricture, unless this be guarded against in the course of healing.

Treatment.—This is conducted in accordance with the principles laid down in the treatment of chancroid. (See page 50.) Stricture must be guarded against by the use of a meatus bougie during the process of healing.

TUBERCULAR URETHRITIS.—Tubercular lesions of the urethra are extremely rare. When observed, they are usually part of a general uro-genital tuberculosis, the prostate, seminal vesicles, testicles, bladder, and exceptionally the ureters, exhibiting tubercular lesions. Generally the lungs are also invaded.

Since the infection is usually descending and is carried by the urine, its manifestations are found in the areas of physiological dilatation, where the urine is most subject to delay,—*i.e.*, in the prostatic, bulbar, and navicular portions of the urethra. The prostatic urethra alone is affected in the great majority of cases. Exceptionally lesions are found along the entire urethra, even extending to the surface of the glans penis.

These lesions may appear in the form of diffuse or clustered miliary tubercles, indolent ulcers, or cheesy infiltrations presenting a diphtheroid surface. The ulcerating lesion may lead to stricture, as in one case reported by Ahrens.

Urethral localization of tubercular lesions is favored by gonorrhœa or by any form of inflammation which lessens tissue resistance and breaks the surface of healthy epithelium. Primary tuberculosis in this region, by direct infection from without, or by localization of the bacilli present in the blood, is practically unknown. The clinical symptoms of a general infection, however, may appear first in the genito-urinary tract.

Symptoms.—The symptoms of urethral tuberculosis are a chronic urethral discharge, and, when the disease affects the posterior urethra, frequency of urination, tenesmus, pain, and often blood at the end of urination. Lesions of the anterior urethra usually excite no symptoms other than a slight muco-purulent discharge. Injection of silver nitrate ordinarily occasions a violent reaction.

Diagnosis.—The diagnosis of urethral tuberculosis is founded on the discovery of the tubercle bacillus, the association of the lesions with evidence of tubercular infection in other parts of the body, particularly in the genital tract and in the lungs, and urethroscopic examination. An apparently causeless purulent urethral discharge should always suggest a careful search for tubercle bacilli.

Treatment.—The treatment is dependent upon the extent and multiplicity of lesions other than those found in the urethra. When the urethral infiltration is simply a part of a general infection, irrigation, and instillation of bichloride solution 1 to 6000 once daily, and the use of iodoform bougies ten per cent. in cacao butter or gelatin, or of iodoform insufflated through the tube of an endoscope, represent as active local treatment as is serviceable. A single or limited infiltration should, in the absence of lesions elsewhere, be thoroughly curetted or removed by an external urethrotomy, the urethra being resected and subsequently sutured should complete removal require this.

TYPHOIDAL URETHRITIS.—The urethral inflammation sometimes accompanying typhoid fever is probably dependent upon congestion induced by the concentrated febrile urine, which in turn favors infection by the Bacillus coli communis and other pyogenic bacteria. The discharge is muco-purulent in character, rarely profuse, contains abundant pyogenic bacilli, pus-cells, mucus, and epithelium without gonococci. There is always accompanying cystitis.

Prognosis.—During or immediately following the appearance of typhoidal urethritis, but generally later in the course of the fever, there may develop epididymo-orchitis. The latter, however, is generally a pure typhoid infection occurring through the blood. (See page 654.) The urethral discharge promptly disappears as convalescence progresses.

Treatment.—The urine should be rendered bland. Urinary antiseptics are indicated.

INFLUENZAL URETHRITIS is also due to pyogenic infection, and its relation to influenza is coincident.

PNEUMOCOCCIC AND DIPHTHERITIC URETHRITIS are more truly specific, since in these forms the specific bacteria may be abundant and there is (in the diphtheritic) membrane formation.

Symptoms.—These are severe, the discharge profuse, purulent, and blood-stained. There may be shreds of membrane exfoliated. Constitutional symptoms, fever, etc., coexist. Yet rarely does the process extend further than the anterior urethra. The pneumococcic is far less severe than the diphtheritic.

Diagnosis depends on the bacteriologic examination, since false membranes may form in other varieties of severe urethritis.

Prognosis is favorable, the disease being usually short in duration.

Treatment should be constitutional and local. Antitoxin should be employed against diphtheria. Locally, mild antiseptic irrigations are indicated.

GONORRHŒA.

Gonorrhœa is a contagious specific inflammation of the mucous membranes of the genito-urinary tract. It also affects the conjunctiva, the rectum, and possibly the mucous membranes of the nose and mouth. It is alleged that it can attack all the mucous membranes, but evidence upon this point is far from conclusive.

Etiology.—Gonorrhœa depends for its development upon the presence of a specific microbe termed the gonococcus. While it is true that gonorrhœa usually runs a somewhat typical course,—one much longer and attended with more complications than when the inflammation is due to traumatism, or irritation, or infection with the ordinary microbes of suppuration,—this is by no means invariably the case. Even the form of urethritis excited by an irritating injection may exceptionally last for weeks and months, and may be attended by every complication that can possibly develop during the course of an acute gonorrhœa.

The gonococcus when cultivated under favorable circumstances on a suitable medium shows a very small, scarcely perceptible grayish surface, appearing shiny, moist, and slightly yellowish by reflected light. The development of this culture is slow, and the growth never extends widely, reaching its uttermost dimensions in two or three days, after which time the germs lose their virulence, and shortly can no longer be transplanted with successful results. This growth is always on the surface. Baumgarten states that in twenty-four hours its extent is not more than one to one and a half millimetres. It is inhibited by extremely weak antiseptic solutions.

Gonococci grow best at a temperature of 34° to 37° C., and human blood-serum is the culture medium of choice. Even in this medium. however, pure cultures are obtained with difficulty, since, because of the slow growth of the gonococcus, its culture is interfered with by the rapid proliferation of other pyogenic organisms.

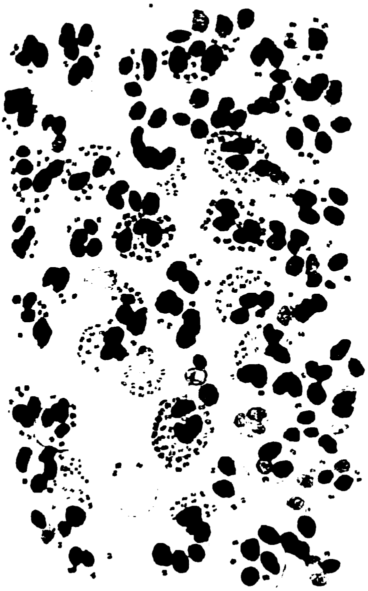
Torro asserts that the difficulty in cultivating the gonococcus lies in the fact that alkaline media have been employed. In acid urine the gonococcus develops rapidly; this suggested to him the idea that acidity is a requisite in all media. He employed ordinary nutrient gelatin without neutralizing, and obtained growths of the germ. He also asserts that he has reproduced the disease from pure cultures obtained by inoculating dogs. The cultures kept in acid media retain their virulence for many weeks, whilst those transplanted to alkaline media quickly become inert.

It must be remembered that, even under favorable circumstances and on the most approved media, pure cultures of the gonococcus cannot always be obtained. Pus swarming with apparently virulent organisms may be placed on proper media without growth.

The gonococcus is distinguished by its shape, grouping, position, color reaction, and growth on artificial media.

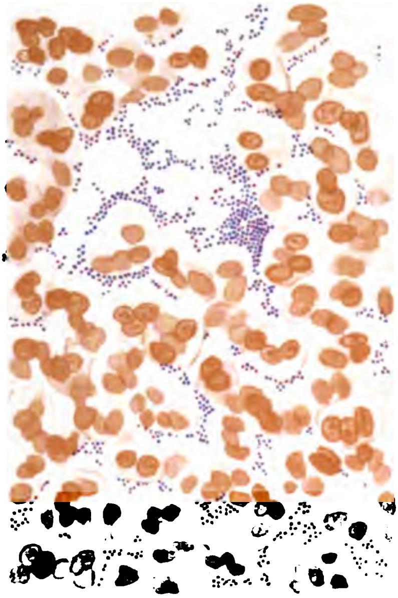
In shape the gonococci resemble the two seeds of a coffee-bean,—that is, they are diplococci, flat or slightly concave on one side, and rounded on the other, with their flat (Figs. 54–57) surfaces apposed. It must be remembered that only by careful staining and by the use of high power can these micro-organisms be seen as diplococci. The two half-spheres are separated by such a very narrow interval that this is not perceived by the use of the ordinary one-fourth or one-eighth lens. In the process of multiplication each half of the diplococcus divides at right angles to the fissure between the two. Hence the gonococci are always grouped in irregularly shaped colonies; chains are never found. They quickly take the stain of ordinary basic staining reagents, such as fuchsin, methyl or gentian violet, or methylene blue, and are

Fig. 54.



Acute gonorrhœa.

Fig. 55.

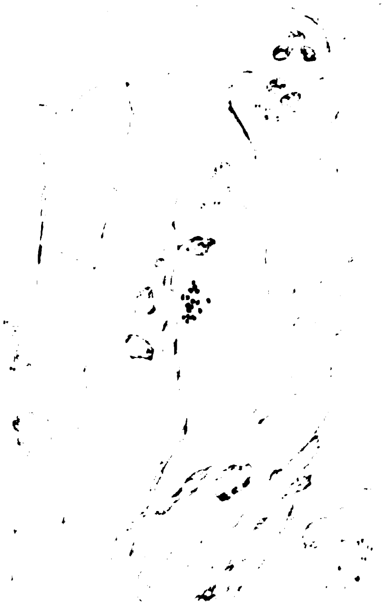


Acute pyogenic urethritis.

Fig. 56.

Chronic gonorrhœa.

Fig. 57.



Urinary shred.

readily decolorized by the Gram method, this fact serving to distinguish them from other urethral cocci.

The diagnosis of gonorrhœa depends upon the discovery of the gonococcus. To this end the following office method if properly applied is usually efficient, and is applicable to all varieties of urethral discharge.

Reagents needed :—

1. The anilin water staining solution of Fraenkel-Ehrlich, made as follows: To one hundred cubic centimetres of two per cent. solution of carbolic acid in distilled water add about five cubic centimetres of anilin oil, drop by drop, shaking after each addition, until the fluid remains opaque after having been shaken. Filter through moist filter-paper, and add to the clear resultant solution, alcohol ten cubic centimeters, and saturated alcoholic solution of gentian violet, fuchsin, or methylene blue, eleven cubic centimetres.

2. Gram's solution:

Iodine, 1 part;
Potassium iodide, 2 parts;
Water, 300 parts.

3. If counter-staining is desired, saturated solution of Bismarck brown in two per cent. carbolized water may be employed.

4. Ninety-five per cent. alcohol.

Technique: The patient should not have voided urine, nor used any form of local urethral injection for a length of time (variable with the amount of discharge) before the examination is to be made. The region about the meatus should be gently cleansed with a pledget of cotton moistened with alcohol to avoid bacteria from this source. The urethra may then be stripped, so that a small drop of pus may appear at the meatus. A perfectly clean, clear, thin cover-glass is then touched lightly to the discharge at the meatus, so that a fraction of a drop will adhere. This readily occurs in all purulent discharges; if the discharge is pure mucus, the glass may have to be washed with ether. A second cover-glass is then made to press gently on the drop, and is drawn off horizontally, so as to make an even spread on both cover-glasses. Both smears are allowed to dry in the air. Each one is then passed slowly three times through the flame of an alcohol-lamp or Bunsen burner, to fix the albumin, care being taken not to burn the specimen. One of the preparations is then held film side up (preferably in a pair of spring forceps) and a few drops of the gentian-violet staining solution dropped upon it. This is allowed to remain from two to five minutes. The staining process may be hastened by heating. The excess of solution is then gently washed off, the preparation blotted between folds of filter-paper, mounted in balsam, and examined with one-twelfth oil immersion lens. If no cocci of any kind are found, the examination need go no further. Commonly, however, a great many cocci are seen, bearing close resemblance to the shape, size, and arrangement of gonococci, if not identical in morphological characteristics. These, together with the epithelial cells, leucocytes, bacilli, and other structures in the smear, are stained deep blue or violet, depending on which stain is used. In such a case the Gram method must be employed in order to differentiate the organisms.

If in ordinary acute urethritis the clinical symptoms are clearly those of gonorrhœa, the above may be omitted and the following process carried out in the beginning. It may be done after a little practice in a few minutes.

1. Take the second smear which has been dried and fixed, cover with the anilin-water-gentian-violet staining solution, and allow to remain two to five minutes.

2. Shake off the excess of stain. Do not use water or alcohol to wash it off.

3. Immerse in Gram's solution for one to three minutes. In this solution the preparation becomes nearly black.

4. Wash in ninety-five per cent. alcohol until all the violet color has disappeared,—*i.e.*, until the specimen appears colorless or has only a steel gray tint.

5. The alcohol is now washed away with water, the smear dried between filter-paper, and mounted in balsam.

In this specimen the gonococci and epithelial and pus-cells may be seen unstained; all other organisms will be stained purple or violet.

A more beautiful specimen, one less trying to the eyes and in which the gonococci are more easily seen, may be made by counterstaining the specimen with the Bismarck brown. The latter stain may be applied after washing off the alcohol with water and allowed to remain two to three minutes. The preparation is then finally washed with water, blotted, and mounted. In this case the cells and gonococci will be easily seen of a yellowish-brown color, in contrast to the deep purple of the other organisms.

If with this method there are discovered in urethral pus the characteristic *biscuit-shaped diplococci*, arranged in *pairs*, *fours*, and other *multiples of two*, showing a tendency to *rectangular disposition*, and located *within* the cellular elements, the diagnosis of gonorrhœal urethritis is sufficiently positive for all clinical purposes. If, however, negative results are obtained,—*i.e.*, if gonococci are not found,—we cannot be absolutely sure the patient has not gonorrhœa.

In medico-legal cases or in cases involving a question of chastity or of family relations, repeated examinations may be required and the concurrent circumstances should be given full weight in reaching a conclusion.

Failure to find the organisms may be incident to faulty technique or to imperfectly prepared reagents. The organisms may be so deeply situated in the submucous tissue or the paraurethral glands that they are found in the discharge only when it has been aggravated. Hence it is helpful to make the examination the morning after a night of dissipation or a dinner of highly irritating food, or a horseback or bicycle ride, or to set up a more or less acute superficial inflammation by instrumentation or irritating injection, or to examine the discharge expressed by massage of the prostate, seminal vesicles, and Cowper's glands. Moreover, there are certain other cocci (the micrococcus catarrhalis and diplococcus intra-cellularis meningitidis) which also are negative to Gram, but these organisms are not found in the urethra.

Microscopic examination will note in the mucoid discharge varying relative quantities of mucus, flat and columnar epithelium and fibrin, together with a few leucocytes, some normally existing non-virulent bacteria, and perhaps a few spermatozoa. In the purulent exudations, in addition to these elements, will be found myriads of pus-cells, various pathogenic bacteria, and in some cases blood-cells.

The mucoid discharge occurs throughout the entire course of the disease only in urethorrhœa. The muco-purulent discharge is characteristic of the early and late stages of gonorrhœa and of the entire course of all the other varieties of urethritis except when they develop in hyperacute form.

The purulent discharge is particularly characteristic of gonorrhœa. It is noted in other forms of urethritis when the infection is unusually severe.

Urethral shreds are of the same mucoid, muco-purulent, or purulent character. In general the mucoid shreds are light and float near the surface of the urine, the purulent ones sink in the fluid, and the muco-purulent occupy a middle position in the glass after the urine has been allowed to stand.

In examining the shreds microscopically they are taken from the urine by means of a platinum loop, pipette, or small forceps, placed on the slide, the excess of water absorbed by blotting-paper, and the specimen stained in exactly the same way as in the discharge from the meatus. The pus-cells are shrunken, degenerated, and fragmented from resorption of water. The gonococci are never so abundant, and require for their demonstration more technical skill.

In the mucoid discharge there are a few bacteria scattered between the cells, in the muco-purulent they are abundant and in groups, and in the purulent discharge they exist in myriads, apparently both within and without the cells, in chains and clumps.

The position of the gonococci is exceedingly characteristic. They are always found heaped in the protoplasm of the pus and epithelial cells. At times the cells appear entirely filled with these organisms.

The number of gonococci in acute typical gonorrhœa is very considerable; though there may be an admixture of other micro-organisms, these latter are distinctly in the minority. At the very beginning of an acute attack, or in its terminal stages, there may be very few gonococci. It is here only that Roux's test is valuable, since the shape, grouping, and number in the midcourse of an acute attack are absolutely characteristic.

The important characteristics of gonococci may be summarized as follows: they are diplococci; they appear in heaps, which nearly always occupy the protoplasm of cells; they are very numerous in acute cases; they are readily colored by aniline dyes and decolorized by Gram's solution and alcohol; they form characteristic pure cultures on suitable media (acid); and are non-pathogenic to lower animals.

Source of the Discharge.—If from the anterior urethra, it appears at the meatus either spontaneously or after stripping. If from the posterior urethra, it is noted just before urination or during the passage of hard feces, or after thorough irrigation of the anterior urethra in the second or third beaker in the three-glass test. If from the prostate and seminal vesicles, it appears after milking these glands, If from the bladder, it is noted at the end of micturition. Origin from combined sources is common.

Pathology.—The gonococci, having been deposited on the surface of the mucous membrane, multiply rapidly and penetrate the epithelium, shortly reaching its deepest layers, but stopping abruptly at the subepithelial connective tissue.

In twenty-four hours after this invasion of the deeper epithelial layers there is an active migration of leucocytes, separating the epithelial cells, and often causing exfoliation, usually of those lying superficially, at times of complete layers. Regeneration follows very quickly, particularly in young men. According to Bumm and Baumgarten, only mucous surfaces provided with cylindrical epithelium or epithelium transformed into this variety are subject to infection. Thus they explain the immunity of the buccal and part of the nasal mucous membrane and of the vagina of adults. This is also interesting in reference to the method of spontaneous cure of gonorrhœa, since where the micro-organisms most deeply invade the tissues there is formed during the process of healing a many-layered, horny, flat epithelium. The anatomical alterations consist in reddening, swelling, and free discharge, first of thin fluid, later of thick pus often mingled with blood. The mucous membrane shows erosions, and, very exceptionally, distinct ulcers. The crypts, follicles, and gland-ducts become swollen, often blocked with pus-plugs, and form sacs containing pus and degenerated epithelium.

Clinically, gonorrhœa may be acute, subacute, or chronic, and each of these forms may have its lesions more intensely marked in either the anterior or the posterior urethra.

Typical Acute Gonorrhœa of the Male Urethra.—This form of urethral inflammation is due to infection of the urethra with the gonococcus. Such infection is nearly always due to sexual intercourse, the virulent pus from the female entering the male urethra to a greater or less depth. This method of acquiring the disease is termed immediate contagion.

The disease also may be conveyed by mediate contagion,—that is, through the medium of clothing or other articles containing specific micro-organisms. Since to excite inflammation the micro-organism must gain access to the urethra, it can readily be seen that mediate contagion, excepting by the agency of bodies introduced within the urethra, must be exceedingly rare.

INCUBATION.—There is always an interval of time between exposure to contagion and the development of noticeable urethral symptoms. During this time the germs are multiplying, and a focus of inflammation is becoming established sufficiently extensive and intense to excite attention. This time varies between a few hours and two or three weeks, since it depends upon the original strength of the microbic invasion, the seat of entrance, and the vital resistance of the mucous membrane. An extremely short incubation period or one which is unusually long should always lead the surgeon to doubt the gonorrhœal nature of the urethritis till this is determined by microscopic examination. Three to five days represent the ordinary incubation period,—that is, the time elapsing between exposure to the disease and the development of the first symptom.

PRODROMAL SYMPTOMS.—Often the first symptom of a developing urethritis is a constantly recurring tendency to fix the attention on the penis. Even though the parts seem perfectly normal, there is a strong desire to subject them to frequent inspection.

A sense of heat and itching in the glans, slight fugitive tickling sensations at the meatus, together with a feeling of weight and tension in the penis and a tendency to develop erection on the slightest excitement, are most frequently noticed.

INFLAMMATORY SYMPTOMS.—In twenty-four hours symptoms of inflammation become more pronounced: there are now developed (1) swelling of the meatus and (2) discharge, becoming more and more marked from day to day, and shortly supplemented by (3) ardor urinæ and (4) chordee; later by (5) frequent urination and vesical tenesmus.

Inflammatory Swelling.—1. The lips of the meatus are swollen and œdematous, often everted, or even eroded. At times the swelling is so great that the urine can be passed only in a slow stream. Usually the stream is forked and irregular.

In severe cases the glans becomes gorged with blood, and the foreskin may be swollen, reddened, and œdematous. Enlarged lymphatic vessels may be felt passing as hard cords from the frænum to the back of the penis.

The urethra swells and becomes tender on pressure. It is at times nodular, owing to involvement of the glands and follicles.

2. *The discharge*, at first scanty and of milk-and-water color, turns to a greenish yellow, and is frequently mixed with blood from the congested mucous membrane. It varies in quantity in accordance with the extent and violence of the inflammation, increasing till the disease has reached its acme.

In the first stage of the disease the discharge is thin, gray-white, and made up of mucus and of pavement epithelial cells, with a very small amount of pus. Gonococci are usually free; some groups are found in the epithelial cells. As the disease increases in intensity the epithelial cells and the mucus give place to pus-cells and the gonococci become very abundant; the discharge is thick, yellow, greenish, or distinctly blood-stained, and very profuse. As the disease passes into the stage of decline the pus-cells are less abundant, and the discharge lessens, becomes milk-and-watery in color and contains much mucus, and shows on examination many flat transitional epithelial cells. Finally, the pus entirely disappears, usually leaving for days or weeks an oversecretion of mucus, which appears in the urine as long, irregular, translucent shreds.

However profuse the discharge of posterior urethritis, it never passes forward, this being prevented by the tonic contraction of the compressor urethræ muscle.

When gonorrhœal inflammation involves the posterior urethra without occasioning symptoms it can be detected only by an examination of the urine, which will be found to be far more cloudy than can be accounted for by the very slight anterior discharge. The existence of inflammation of the posterior urethra may be still further confirmed by causing the patient to pass his water in two portions. The first part will, of course, wash clean both the anterior and the posterior urethra. Should the second part be clouded from pus or mucus, this (in the absence of cystitis or pyelitis) is a positive sign of involvement of the posterior urethra, since the pus produced in the pars posterior must necessarily, if it be secreted in any large quantity, first fill the prostatic urethra, and then flow back into the bladder and become mingled with the urine. If there be but a small amount of pus secreted, it will remain in the prostatic portion of the urethra and will be carried away with the first urine: hence, if the patient micturates frequently or the discharge is slight, the second urine will probably remain clear.

In this case the source of the pus may be determined by passing a small soft catheter into the urethra until its point encounters the resistance caused by the contraction of the compressor urethræ muscle. All the pus lying in the anterior urethra is now washed away by forcibly injecting a stream of water through the catheter until it escapes from the meatus clear; six or eight ounces of boric acid solution should be used for this washing. Immediately after this irrigation the patient is instructed to urinate in two portions. If the first portion of water passed contains pus, while the last part is clear, it shows that there is inflammation of the posterior urethra, causing a discharge not sufficiently profuse to fill the prostatic urethra completely and flow backward into the bladder. Even this test is not absolutely accurate. The flushing out of the anterior urethra with a one per cent. solution of methyl blue, followed by urination and microscopic examination of shreds, would show if the latter remained unstained that they probably come from the posterior urethra.

It is only in acute freely discharging cases, then, that the second urine is always cloudy. In slight cases this cloudiness will be observed only after retention, or may not be found at all.

Since there is prolonged retention of urine at night, it is best to examine the urine passed in two portions on rising in the morning. The second portion of this will nearly always show the presence of pus, even though the posterior urethritis be of light grade.

3. *Ardor urinæ*, or pain during urination, becomes well marked within the first few days. The pain is commonly referred to the

meatus or to the navicular fossa. It is often felt, however, along the entire anterior urethra, and may even be reflected to the anal region. This pain is caused mainly by the action of acid urine on the inflamed mucous membrane, as is shown by the soothing effect of alkaline diuretics.

Not only is there burning on urination, but from slight mechanical disturbance, or even without obvious cause, sharp, cutting, stabbing pains are felt along the course of the pendulous urethra at various times. These may be so constant and annoying as to prevent all but absolutely necessary movements.

4. *Painful Erection.*—Even in the period of incubation there is usually increased sexual excitement, manifested by frequent and long-continued erections and even by increased pleasure in copulation. As the inflammation becomes more intense and wide-spread the erections become more persistent, and are accompanied by pain which is often so severe that it constitutes one of the most harassing symptoms of the disorder. This pain is due to the fact that the congested infiltrated mucous membrane and submucous connective tissue is not able to stretch as it normally does when the cavernous bodies become engorged with blood. The tension upon the now non-elastic urethra is still further increased by a clonic contraction of the ischio-cavernous and bulbo-cavernous muscles, which swing the penis upward against the abdominal walls.

Painful erection is present to a greater or less extent in all cases. It occurs most frequently during the sleeping hours, though it may give trouble at any time, day or night. The pain is felt mainly along the under surface or on the sides of the penis, and by its persistence either awakens the patient or keeps him awake.

When inflammation is unusually severe, chordee develops,—that is, during erection the penis is curved or bent, usually downward, though lateral or upward curving is sometimes observed. In these cases the pain is generally severer than when there is no such deformity. The marked bending of the organ is due to the fact that the inflammation extends to the submucous connective tissue, and thence to the trabeculæ of the erectile tissue of the spongy body. The exudation of lymph consequent upon this fills up the intertrabecular spaces, which by engorgement furnish the ordinary mechanical element of normal erection. When the organ becomes erect the corpora cavernosa are fully engorged with venous blood. The infiltrated portion of the corpus spongiosum, however, remains rigid and undilatable, the blood being unable to find its way into the partially obliterated spaces. If the inflammation extends to the corpora cavernosa, erections will be equally painful; but in this case the curve will be upward. If only one cavernous body is involved, the curve, of course, will be towards the affected side.

The almost unbearable pain of chordee may lead the patient to adopt extreme measures for its relief. At times the arch is broken by a sudden blow of the fist, the penis being placed on some hard, flat surface. The result of this treatment is a rupture of the urethra, either partial or complete, with subsequent formation of a dense stricture as the least serious consequence.

At times patients have endeavored to obtain relief by intercourse. The results are nearly as disastrous as those consequent on forcible breaking, at least one death being attributable to this method of treatment.

The inflammation always involves the posterior urethra extending back thus far in three to five days. Often the involvement is so slight as to occasion no symptoms other than the presence of pus in the second part of the morning urine when it is passed in two portions. Prodromal symptoms of ACUTE POSTERIOR URETHRITIS may not be observed before the end of the second week. In the third week they are usually most pronounced. They may not develop till a much later period,—in the course of relapses, for instance. When the gonococci have been carried backward by bougies or by injections, well-marked posterior urethritis may develop in the first days of the attack.

Prostatitis, vesiculitis, epididymitis, and urethro-cystitis are the ordinary complications of posterior urethritis. A true gonorrhœal cystitis is extremely rare, and is always due to mixed infection, since the gonococci are not prone to attack surfaces covered with squamous epithelium.

Subacute and chronic gonorrhœa are liable to be complicated by rheumatism, ophthalmia, endocarditis, myelitis, and other manifestations of septic absorption.

When the posterior urethritis develops suddenly as a result of exposure or excesses, it runs an acute course, and is ushered in by very characteristic symptoms, which reach their height in one or two days.

The attack begins with painful, urgent, and frequent micturition and the appearance of pus in the last portion of urine, associated with an attack of what the patient calls grippe or malaria. In severe cases these symptoms are followed by perineal pain, persistent erections, nocturnal pollutions, hæmaturia, albuminuria, and sometimes retention of urine. The general symptoms are much like those of a severe attack of grippe.

5. *Urgent and Frequent Urination.*—Normally, when the bladder be-

comes moderately distended, the internal vesical sphincter dilates and the urine comes in contact with the prostatic urethra. This occasions a desire to urinate so slight that the act may be postponed with comfort for hours. When, however, the prostatic urethra is inflamed and hypersensitive, the first contact of urine on the yielding of the internal sphincter excites an uncontrollable desire to evacuate the bladder contents.

In the hyperacute form the patient is compelled to micturate every few minutes, but passes, after great straining, attended by almost unbearable pain, only a few drops of urine, without any relief being afforded to the intense desire to urinate. From swelling of the mucous membrane and reflex tonic contraction of the vesical sphincters there may be obstinate retention of urine.

When inflammation is less acute the constant straining is replaced by frequent urination and a precipitancy in the act; that is, when the desire to urinate is felt, it immediately becomes so urgent that the water is retained only with great difficulty. This latter symptom is highly characteristic, and is readily explained on physiological grounds.

6. *Terminal Hæmaturia.*—In addition to the tenesmus there is frequently hæmaturia,—a few drops of pure blood running from the urethra at the end of urination. This is squeezed from the swollen, congested, often eroded mucous membrane of the prostatic urethra. Hemorrhage may be very free. In this case the blood will flow back into the bladder, and the patient will pass it mixed with his urine and after the latter has ceased flowing.

7. *Albuminuria.*—During the period when vesical tenesmus is most marked there is always a quantity of albumin in the urine greater than can be accounted for by the pus present. This is probably due to damming back of the urine in the ureters, dependent upon closure of the orifices of these canals by contraction of the detrusor muscles of the bladder, this having been shown to take place when tenesmus is severe.

8. *Perineal Pain.*—This when due to tenesmus—*i.e.*, muscular spasm—may be almost unbearable in its intensity. Aside from the suffering by muscular spasm there are usually tickling, burning, or shooting pains in the deep urethra and about the rectum. These are aggravated by micturition or defecation.

9. *Erections* are frequent, but are painless unless there is at the same time acute anterior urethritis.

10. *Nocturnal emissions* occur repeatedly, and are almost symptomatic of inflammation of the posterior urethra. They are due to

hyperæsthesia of the caput gallinaginis, and are often painful, the distress being referred to the deep urethra.

11. *Constitutional Involvement.*—Even in mild cases there are, as a rule, transitory fever and slight malaise. Incident to acute posterior involvement, even when the local symptoms are not especially well marked, there are often pronounced fever, headache, pains through the body, particularly in the back, loss of appetite, and the general misery so identified with "grippe" that the patient himself usually makes this diagnosis of his condition.

Unless checked by appropriate remedies, the symptoms steadily increase in severity for about two weeks; this constitutes the increasing stage. During this time gonococci have invaded the entire urethra and have penetrated to the deepest epithelial layers.

For about one or two weeks the symptoms remain stationary (stationary stage); they then gradually subside (subsiding stage), ardor urinæ and painful erections entirely disappearing, and the discharge becomes thinner, clearer, and more scanty, till, in about two weeks more, it is entirely suppressed.

Acute gonorrhœa may be greatly prolonged by relapses or by depressed conditions of the system rendering the tissues less able to resist or eliminate the disease. Relapses may be occasioned by exposure to cold, by over-exertion, by excesses, or by the congestion incident to seminal emissions, which are, in turn, excited by the acute inflammatory process.

"Russian clap" is the vulgar name applied to gonorrhœa of a hyperacute type. In these cases there are swelling of the glans and foreskin, lymphangitis, free bloody discharge, great sexual excitement, frequent seminal emissions, and obstinate chordee. Bleeding is due to rupture of the intensely congested vessels of the urethral mucous membrane, and both the pus and the semen are distinctly blood-stained.

Gonorrhœa may terminate in resolution or in chronic urethritis, or may be followed by stricture.

Complications.—In the increasing stage, balanitis, balanoposthitis, phimosis, and paraphimosis are the common complications; in the stationary stage, folliculitis and periurethritis, lymphangitis, lymphadenitis, cavernitis, and Cowperitis.

Prognosis of Acute Gonorrhœal Urethritis.—This specific inflammation runs its course in from five to eight weeks. If carefully treated, the discharge disappears, the urine remaining absolutely clear of shreds, and the disease is cured. At times, even though treatment has been judicious and has been rigidly carried out, the acute inflammation runs into the chronic form, manifested by a gleety discharge, lasting longer than eight weeks; or, in the case of the posterior urethra, by constantly recurring subacute attacks and sexual neuroses of all types. This is especially liable to occur in the strumous and cachectic, in those of gouty or rheumatic tendency, and in patients who are careless in respect to treatment and impatient under restraint. The prognosis as to the time when cure can be expected must always be guarded.

Treatment of Acute Gonorrhœa in the Male.—PROPHYLACTIC MEASURES.—The use of a cover sufficiently strong to remain unbroken during coitus, followed by careful ablution and urination immediately on completion of the act, is the only reliable means of preventing contagion. In the majority of instances the cover is dispensed with, the washing and urination being relied upon to dispose effectually of any contagious matter. In this case the flushing out of the urethra may be made more thorough by passing the urine in as full a stream as possible and suddenly stopping its flow by occluding the meatus. This widely distends the anterior urethra and causes the water to penetrate to all portions of the fossa navicularis and even to the lacuna magna. This result is not obtained by ordinary urination. When passed in the way directed, the mechanical cleansing effect is superior to that of an injection, and the urine is at the same time far less irritating to the mucous membrane.

Among those who are constantly in the habit of exposing themselves to contagion, the employment of antiseptic injections immediately after coitus is popular. If such injections are employed, they should be so weak that no irritation of the mucous membrane will be involved. Since it has been shown that the contagious pus does not penetrate deeper than the fossa navicularis, the injection should not extend beyond the first inch of the urethra, and since to be efficient the injection must destroy all gonococci, it must be so applied that it will reach every portion of the fossa navicularis. Protargol, a grain to the ounce of distilled water, is probably the best solution that can be employed as a prophylactic injection. Bierhoff commends a twenty per cent. protargol glycerin solution, three minims of which are dropped into the fossa navicularis.

The use of such injections should be preceded by urination. Even when they are most skilfully administered they do not afford certain immunity against the development of gonorrhœa. Irritating injections may in themselves cause a persistent discharge most rebellious to treatment.

THE ABORTIVE TREATMENT.—The treatment of gonorrhœa in its early stages by strong irritating injections, particularly those of silver nitrate, with the idea of substituting an acute inflammation for the specific process and thus aborting the latter, is now seldom employed. Increased severity and longer duration of inflammation have been noted in cases thus treated, and tight strictures are much more frequently observed than when gonorrhœa is treated by less heroic measures. There is reason to believe, however, that employed in the right way and at the right time the abortive treatment of gonorrhœa is justifiable, since it is followed at times by prompt cure, and if it fails it does not seriously aggravate the original disease. Two methods of treatment may be adopted with the idea of aborting the disease:

1. Injections of strong solutions of organic silver salts.
2. Copious flushings with weak antiseptic solutions.

1. *Injections of Strong Solutions of Silver Salts.*—It has been shown experimentally that silver salts act as powerful germicides upon the gonococcus. Both the gonococcus and the silver salts produce the same effect upon the urethral mucous membrane,—that is, they cause a desquamation of the epithelium and an active inflammation of the deeper structures. The silver salts, however, act very rapidly,—within a few hours; the gonococcus requires several days to produce its full irritant effects. If, then, before the gonococcus has time to penetrate more deeply than the superficial layers of the epithelium an injection of silver is employed, it seems fairly reasonable to hope that it may not merely destroy the microbes, but may also cause them to be thrown out from the urethra by occasioning almost immediately an active inflammatory discharge, which, since it is solely due to a chemical irritation, may be expected to subside entirely within a few days. If, however, the gonococcus has had time to penetrate deeply, further irritation cannot accomplish its extrusion, but will simply diminish tissue resistance and add to the pabulum of the invading microbe, thereby increasing its multiplying powers.

It is, therefore, clear that the abortive treatment should not be attempted except in the very earliest period of a gonorrhœa,—that is, when the tickling of the meatus, the drop of clear or slightly cloudy discharge, made up of mucus and epithelium, and the extra cellular position of the gonococci denote that the inflammatory process has not extended deeply. A red or injected meatus with swollen, everted lips, a turgid glans, marked ardor urinæ, and particularly free purulent secretion, constitute absolute contraindications to this treatment, even if the case is seen early in its course. The injection should be made of five grains of protargol to the ounce of distilled water. This is not strong enough to produce an inflammation of sufficient depth and intensity to be followed by subsequent cicatricial contraction. The patient first urinates, and has ten drops of a four per cent. solution of eucaine injected into the urethra. Into the meatus, the lips of which are held open, several drops of the protargol solution are allowed to fall. Then the nozzle of the syringe is introduced and about one drachm of the solution is injected, and is held in for three minutes by withdrawing the syringe and compressing the meatus. This injection is repeated every two hours; each time the ounce bottle becomes half empty it is filled to the top with distilled water. At the end of the first day the dilution becomes 1 to 200, at the end of the second day 1 to 800, at the end of the third day 1 to 3200. The discharge diminishes and becomes mucoid, the gonococci disappear, and, if the treatment prove successful, there may be complete recovery in seven days. Even though the gonococci disappear, a slight discharge often persists.

Usually when patients appear for treatment the gonococci have penetrated to a depth beyond the reach of the silver solution. Even when the case seems suited to this treatment prognosis as to prompt cure must be guarded. There need be, however, no fear lest such treatment should directly cause stricture. As a rule, even when the injections fail to eliminate the gonococci and check the discharge, they do not after the first day aggravate the inflammatory phenomena, increase the liability to posterior complications, or prolong the treatment.

In this or in any other abortive method of treatment the patient should be given directions in regard to diet, exercise, and medication, which are found in detail under the Systematic Treatment of Acute Gonorrhœa.

2. *Copious Flushings with Mild Antiseptic Solutions.*—This treatment is sometimes followed by rapid cure when practised in the early stages of gonorrhœa. The technique of this method is described later. (See page 138.) It may be combined with the injection treatment.

Systematic Treatment of Acute Gonorrhœa.—The first point to be considered in the methodic treatment of acute gonorrhœa is to remove as far as possible all additional sources of irritation. Among these are:

1. The influence of bodily activity, which always occasions more or less friction and local congestion.
2. The congestive effect of sexual excitement.
3. The irritating effect of acid urine.

The best way to avoid the deleterious effect of bodily exercise is to order rest in bed, thus reducing in activity all the processes of the body and exercising a powerful influence in controlling local congestion. This is well shown by the ease with which gonorrhœa is cured in hospital practice. Although this treatment rarely can be carried out, it is useful to insist upon the nearest practicable approach to it. The patient should be instructed to avoid all active exercise, to walk as little as possible, to sit rather than stand, and, whenever possible, to lie down with his hips elevated.

Since inflammation of the urethra is frequently attended by marked sexual erythism, the patient should be made to understand very clearly that the hyperæmia engendered by even moderate sexual excitement distinctly aggravates the inflammation and postpones his cure: hence he must avoid company, reading, or thoughts which might produce local congestion.

Careful attention to diet is of cardinal importance in rendering the urine bland. If the patient can be limited to skimmed milk during the increasing stage of the disease, the chances are largely in favor of his escaping without ardor urinæ or chordee. Unfortunately, very few patients can adopt this diet, since so marked a departure from the ordinary regimen would be certain to excite attention. In such cases, or when from choice the patient refuses to be restricted to skimmed milk, he should be instructed to take very little meat, to avoid greasy, fried, or highly seasoned articles, and to abstain from the use of pepper, vinegar, salt, coffee or tea, salad dressing, asparagus, acid fruits, tomatoes, pastry of all kinds, and all articles of food difficult of digestion. Alcoholic drinks of all kinds must be interdicted, particularly champagne, beer, and gin. If to avert suspicion it becomes necessary for the patient to take some form of alcoholic liquor, claret should be chosen as the least hurtful.

Effervescing mineral waters or ordinary water may be taken freely, but not to the extent of interfering with digestion. Harassing painful erections are controlled by potassium bromide one to three drachms, camphor monobromate ten to twenty grains, or hypodermics of morphine one-quarter to one-half grain, at bedtime; intense ardor urinæ by four per cent. eucaine solution to the meatus, or urinating with the penis hanging in hot water.

The moderate use of tobacco is rather beneficial than otherwise, though it should, of course, never be ordered by the physician. Where the habit is already formed, and is practised in moderation, it should not be stopped. Excessive use of tobacco should always be avoided.

During the night the patient should sleep on a hard bed, and should not be too warmly covered. He should rise once during the night to pass water, thus not only washing out the urethra, but also removing a cause of erection and consequent local congestion. Before retiring he should be instructed to take a hot bath, lasting from ten to twenty minutes; this by equalizing the circulation powerfully modifies local congestion. It is often an efficient means of lessening or preventing painful erections. The bowels should be moved regularly, a simple saline, such as effervescing Vichy, taken early in the morning, answering well.

For the purpose of rendering the urine entirely bland, in addition to the milk diet and the free use of water, it is well to prescribe an alkaline hydragogue diuretic, combining with it an arterial sedative and an anodyne, directed especially to subduing the activity of the genital function. There are many ways in which these ends may be attained, but the following prescriptions satisfactorily fill the indications:

℞ Tinct. aconiti rad., gtt. xvi;
Pot. brom., ℈viii;
Pot. acetat., ℥ss;
Infus. pareiræ bravæ, q. s. f℥viii.
M. S.—f℥ss in water every two hours.

℞ Tinct. verat. vir., gtt. viii;
Pot. brom.,
Sod. bicarb., āā ℈viii;
Liquor pot. cit., f℥viii.
M. S.—f℥ss in water every two hours.

Two five-grain tablets of potassium citrate may be given three times a day after meals.

Dressing.—The selection of a dressing which shall collect and absorb the discharge, and which shall yet be neither heating nor cumbersome, is a matter of cardinal importance. The use of the rubber bags or pouches sold for this purpose is to be condemned; the securing of dressings by tapes or bandages bound about the penis is also objectionable.

If the foreskin entirely covers the penis, the best dressing consists in the application of a small pledget of antiseptic absorbent cotton. This is retained in place by drawing the prepuce forward. It should not be allowed to become glued tightly to the meatus, so that the free escape of pus will be interfered with. If the foreskin only partially covers the glans, a slit should be cut in the centre of a piece of lint or of old linen, about two and a half or three inches square. This slit is made just large enough to slip over the head of the penis and back of the corona. The borders should be turned forward, and the foreskin should be brought in the same direction, thus holding the lint or the linen in place. If the foreskin is absent, the foot of an old stocking, or a bag of similar size made out of any thin material, may be pinned to the shirt in front; at the bottom of this is placed a wad of absorbent cotton, and the penis is allowed to hang in the bag. The gonorrhœal bag made of thin permeable fabric, provided with a buttoned flap which can be turned down readily, and fastened as is a suspensory bandage around the loins is an equally efficient and more convenient dressing. Any dressing which on removal is followed by the immediate escape of one or more drops of discharge, thus showing that there is a damming back, should be discontinued.

The patient must be cautioned in regard to the contagious nature of the discharge. He should wash his hands carefully after each handling of the organ or of the dressing, and should be especially warned of the danger of gonorrhœal conjunctivitis. He should be instructed, in addition to other precautions, to keep his fingers away from his eyes. Since gonococcal infection can be carried by means of towels in the bath, particularly to female infants, the patient must be informed of this fact.

The directions above detailed should be given the first time the patient is seen. The importance of rest having been pointed out, the diet having been regulated, hot baths and a diuretic mixture having been ordered, and the proper method of dressing the organ having been explained, together with the danger of infecting the eye, the additional treatment will depend upon the nature of the inflammation. If the case is subacute, the discharge will become more profuse, but no marked subjective symptoms will develop. If the case is one of acute gonorrhœa, symptoms will be severe in inverse proportion to the fidelity with which the regulations given have been observed.

The subacute may be subjected at once to the injection and medication appropriate to the subsiding stage of the disease.

The acute inflammatory gonorrhœa may be treated (1) by internal medication, supplemented later by injections; (2) by immediate antiseptic injections, either with or without internal medication; (3) by copious antiseptic flushings.

1. *Internal Medication, supplemented by Injections in the Subsiding Stage.*—The general directions in regard to rest, diet, the regulation of the bowels, the dilution of the urine, and the dressing of the penis having been given, the question of exerting a direct germicidal action upon the gonococci and at the same time increasing tissue resistance arises. In cases hyperacute from the first, or rendered markedly in-

flammatory in type by excesses or irritating injections, or in those which react unduly to ordinary applications, many surgeons prefer postponing local treatment till the subsiding stage is reached, holding that thus the disease runs a milder and shorter course and that complications, particularly those associated with severe posterior urethritis, are much less common than when injections are used earlier.

If such a treatment is adopted, the remedies appropriate to the almost inevitable ardor urinæ and chordee (page 129) are supplemented by drugs, which, when they are eliminated by the kidneys, exert an antiseptic influence on the gonococci, at the same time slightly stimulating the urethral mucous membrane. Exceptionally even the mildest of these remedies aggravates the urethritis, or so disorders the stomach that its continuance is not practicable. Usually the drugs commonly employed markedly modify the amount of purulent discharge and the violence of the inflammatory symptoms.

Of the remedies which, administered by the mouth, render the urine mildly germicidal, the most potent is salol. This when given alone will materially modify the course of an acute gonorrhœa, but when combined with other antiblennorrhagics is greatly increased in effectiveness. After salol the drugs which most effectually limit the local inflammation are oil of sandal wood, copaiba, and cubebs. Cubebs and copaiba are generally used in the subsiding stage of the disease, since they are supposed to be too stimulating during the acute stages; frequently, however, they form a valuable auxiliary to the antiseptic treatment from the very beginning. A capsule put up according to the following formula (White's) will not only abbreviate the course of gonorrhœa, but will often prevent the development of complications:

℞ Salol, gr. v;
Oleoresin. cubeb., gr. v;
Para balsam. copaibæ, gr. x;
Pepsin., gr. i.

Or, as a change from this, capsules containing:

℞ Salol, gr. iii;
Ol. santal., gr. iii;
Oleoresin. copaibæ, gr. iii;
Ol. cinnamomi, gt. i.

These capsules should be given, the former four to six a day, the latter six to ten. They will be best borne by the stomach if administered an hour after eating.

An emulsion is sometimes better tolerated by the stomach. The Lafayette mixture may then be employed; this is made up as follows:

℞ Balsam. copaibæ,
Spir. lavand. comp.,
Spir. æth. nitrosi, āā ℥ss;
Liq. potassæ, fʒss;
Ol. gaultheriæ, fʒii;
Mucil. acaciæ, q. s. ad f℥iv.
M. S.—Two drachms three times a day after meals.

Urotropin has shown marked antiseptic powers. Five grains are given six times a day when the urine is alkaline.

When these drugs seem to increase local inflammation they must be stopped, the urine being rendered mildly antiseptic by a blander remedy. Boric acid answers well in fifteen-grain doses four times a day. A useful combination, especially when there are symptoms of vesical irritation, is as follows:

℞ Acidi borici,
Sodii bromidi, āā ℈viii;
Tinct. belladonnæ, fʒi;
Liq. potassii citratis, f℥viii.
M. S.—Tablespoonful in water four times daily.

The possible disagreeable symptoms excited by salol and the balsamic remedies may be:

1. Stomach indigestion, characterized by heaviness after eating, pain in the stomach, and gaseous and liquid eructations, bringing into the mouth a taste of the medication.

2. Copaiba urticaria, appearing especially upon the hands, feet, arms, knees, and abdomen.

3. Severe backache, fever, albuminous, smoky, or bloody urine, and sometimes complete suppression of the secretion.

Marked kidney disease is a contra-indication to the use of either salol or the balsams, but not to urotropin.

At the end of the second or third week of the treatment just described the inflammatory symptoms will begin to subside, and the discharge will become somewhat thinner and less abundant. Without any change of treatment a cure may be expected in the majority of cases in ten or twelve weeks. This cure is hastened and rendered more certain by antiseptic and astringent injections.

Injections.—In making these the patient is directed to procure a hard rubber urethral syringe, large enough to hold at least four drachms, and with a nozzle so shaped that, while it cannot injure the urethral mucous membrane, yet when pressed in firmly it will occlude the meatus entirely and thus allow the injections to be conducted in a cleanly manner. Either the blunt hard rubber urethral syringe of the American Rubber Comb Company, or the Goodyear syringe No. 1 C, should be selected. (Fig. 58.) Or if the patient has trouble in employing a piston syringe, a soft rubber bulb provided with a conical point may be ordered. This is easily kept clean and cannot get out of order. It is, however, ordinarily more difficult to use than is the hard rubber syringe, provided the piston of the latter works properly. All syringes with slender or sharp points which can penetrate for some depth into the urethra and still further inflame the mucous membrane must be forbidden.

FIG. 58.

Urethral syringe.

Having procured a proper syringe, the patient should be instructed in its use till he is able in the presence of the surgeon to perform upon himself a skilful and thorough injection.

In making the injection the patient may either sit or stand. He first urinates, then the syringe having been filled is taken between the thumb and middle finger of the right hand, the tip of the index finger resting on the piston. The conical extremity of the syringe is inserted within the meatus, which is held open for that purpose by the thumb and index finger of the left hand, and which is then drawn tightly around the syringe, the pressure being made laterally, thus narrowing the aperture instead of broadening it, as would happen were it compressed vertically. The syringe is depressed so that the nozzle points about towards the umbilicus, and the piston is then driven in.

The liquid should flow into the urethra without any leakage; should dribbling occur, it shows that the finger and thumb of the left hand are not so placed that the margins of the meatus are made to embrace the syringe closely. On the completion of the injection the syringe should be quickly withdrawn, and the meatus should be instantly closed by pressure of the thumb and finger. The injection is thus retained within the urethra for three minutes. The whole anterior urethra should be distended. This requires two or three drachms of solution, and when the injection is first driven in excites a feeling of tension and muscular spasm in the perineum corresponding to the position of the bulb. This sensation indicates that a sufficient quantity has been injected.

The soft rubber bulb is used in the same manner as the syringe, except that the liquid is forced out by compressing its sides instead of by driving home a piston.

Any injection which gives rise to more pain than may be characterized as temporary stinging or smarting is likely to do more harm than good, and should be either withdrawn or diluted. Departure from this rule, save in very exceptional circumstances, is likely to be followed by disastrous results. The aim of the surgeon is to accomplish cure with the weakest efficient injection.

These injections are made after each act of micturition.

Injections are contra-indicated in acute gonorrhœa:

1. When they cause persistent and severe pain and seem to aggravate the severity of the inflammatory symptoms.
2. During the course of an acute posterior urethritis.

The injections which are least irritating and most successful in shortening the course of acute gonorrhœa are the following:

℞ Argyrol, ʒiii;
Aquæ destil., f℥vi.
S.—Use locally after urination.

℞ Hydrarg. chlor. corros., gr. ⅛;
Sod. chlor., ʒi;
Aquæ destil., f℥vi.
M. S.—Locally after urination.

℞ Protargol, gr. v;
Aquæ destil., f℥i.
M. S.—Solution 1 to 100; add twelve drops to a tablespoonful of distilled water and inject. Gradually increase until thirty or forty drops are added.

℞ Pot. permanganatis, gr. i;
Aquæ destil., f℥vi.
M. S.—Dilute with an equal quantity of boiled and filtered water and inject. Gradually increase the strength of the injection.

℞ Zinci permanganatis, gr. i;
Aquæ destil., f℥vi.
M. S.—Dilute with an equal quantity of boiled and filtered water and inject. Gradually increase the strength.

Such injections as those just given, containing only one active principle, are usually less efficacious than those in which the antiseptic and astringent properties of two or more drugs are combined: hence the following prescriptions are much more popular and efficacious when injected by means of the ordinary syringe:

℞ Hydrarg. chlor. corros., gr. ½;
Acidi carbolici, gr. xii;
Zinci sulphocarbolatis, gr. xii to ʒi;
Boroglycerid. (25 per cent.), f℥ii;
Aquæ, q. s. ad f℥vi.
M. S.—Inject after urination, diluting or making stronger according to indications.

This injection has proved more efficacious than any other of the large number popular with the profession. It is appropriate to all stages of gonorrhœa, the strength being regulated to suit individual peculiarities, and combines nearly all the essentials theoretically required of an injection.

When an astringent action seems to be strongly indicated, as shown by continued profuse muco-purulent discharge, uninfluenced by antiseptics, the following will be found useful:

℞ Ext. hydrast. fl. (colorless), fʒvi;
Bismuthi subcarb., ʒvi;
Boroglycerid. (25 per cent.), ʒvi;
Aquæ destil., q. s. ℥vi.
M. S.—Inject after urination.

To this may be added zinc sulphocarbolate in the proportion of five grains to the ounce of water, the bismuth being replaced by this drug towards the end of the attack to enable the surgeon to determine the nature and quantity of the discharge.

Another astringent injection efficacious in the last weeks of gonorrhœa, and serviceable at all stages, is the well-known injection Brou. This is compounded as follows:

℞ Zinci sulphatis, gr. xv;
Plumbi acetatis, gr. xx;
Tinct. opii,
Tinct. catechu, āā ʒii;
Aquæ ad f℥vi.
M. S.—Use as an injection after urination.

Ultzmann's injection is particularly efficacious when in the subsiding stage discharge ceases to diminish under other applications. The formula for this is:

℞ Zinci sulphatis,
Pulv. alum., āā gr. iv ad gr. xii;
Acidi carbolici, gr. iv;
Aquæ, f℥vi.
M. S.—Use by injection, changing the strength in accordance with the indications.

Other astringent injections which may be employed are:

℞ Zinci acetatis,
Acidi tannici, āā gr. xx;
Aquæ rosæ, ℥iv.

℞ Zinci sulphatis, gr. iv ad gr. xii;
Liq. plumbi subacetat. dil., f℥iv.

When the discharge has entirely disappeared the urine should be examined to see whether it contains clap-shreds. If these are present, there must for a time be no abatement in the treatment. If pus is entirely absent, shreds being made up of epithelium and mucus, and other symptoms have ceased, the patient should stop treatment gradually. Injections should be cut down to two a day, to one a day, to one every other day, until, in ten days, they are entirely stopped.

The administration of antiseptics and balsams by the mouth is gradually diminished in the same way, the urine being examined every second or third day for the purpose of demonstrating whether cessation of treatment is attended with reappearance of purulent discharge. After the cessation of all treatment a full week should elapse before the patient relaxes the strict regimen under which he has been living. If at the end of this time his first and last urine is entirely free from discharge, he can safely resume his ordinary habits of life, at least so far as relighting his gonorrhœal inflammation is concerned.

Summary of Treatment by Internal Medication, supplemented by Injections in the Subsiding Stage.—1. The patient is directed to keep as quiet as possible, to avoid all sources of sexual excitement, to render the urine bland by diet, to secure regular daily motions of the bowels, to take a hot bath before retiring, and to sleep on a hard bed with light covering.

2. He is given remedies calculated to make the urine bland, to subdue local inflammation, and when excreted by the urine to exert an antiseptic influence on the gonococci (as salol, oil of sandal wood, copaiba, sodium bicarbonate, sodium bromide, potassium citrate or acetate, hyoscyamus, belladonna, aconite, cubebs, and boric acid). These drugs are pushed till they either produce disagreeable effects or accomplish to a satisfactory extent the object for which they are given.

3. The treatment appropriate for relief of ardor urinæ and chordee is ordered. In the beginning of the subsiding stage an injection is given after each urination. These injections are at first exceedingly weak, are gradually increased in strength as toleration is established, and are made more distinctly astringent in the subsiding stages.

During an acute posterior urethritis injections of the anterior urethra are omitted.

4. Treatment should be continued till examination of the urine shows absence of purulent shreds for at least seven days. It should then be stopped gradually.

The treatment of discharge lasting longer than eight weeks will be considered under the heading Chronic Gonorrhœa.

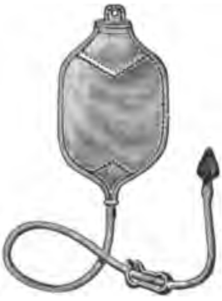
Treatment by Immediate Injection.—This differs from the treatment just described only in the fact that injections are ordered as soon as the patient comes under observation and the diagnosis is confirmed by microscopic examination. The general directions, the internal medication, and the injections are the same as those already detailed.

The contra-indication to this treatment is found in excessively acute cases which are distinctly aggravated by any form of local treatment.

The injection which has given most satisfactory results is that made up of zinc sulphocarbolate, carbolic acid, corrosive sublimate, and boroglyceride (see page 135), supplemented in its action by the salol, copaiba, and cubeb capsules (page 132). Care must be taken that the injection be not too strong when it is first applied. This is determined by the amount of pain excited and the inflammatory reaction which follows the use of the lotion. The first injection of any lotion should usually be weakened by the addition of an equal quantity of sterile water. Towards the end of the subsiding stage the strength may be materially increased. Exceptionally it may be substituted by a more purely astringent lotion.

Copious Irrigation of the Urethra with Dilute Antiseptic Solutions.—This method of treatment, applicable at any stage of gonorrhœal urethritis, will often be attended with more rapid subsidence of inflammatory symptoms than either of the methods already described. The apparatus required is a quart irrigating bag or bottle, a rubber tube leading from this eight feet in length, and a nozzle attached to the rubber tube and shaped in the form of a flattened cone, so that it fits into the meatus and prevents the irrigation liquid from flowing out beside it, thus keeping the urethra distended. (Fig. 59.)

Fig. 59.



Irrigating bag.

In place of the urethral nozzle a small soft rubber catheter (No. 10 F.) may be fitted to the tube leading from the reservoir. This should be lubricated and carried down to the compressor urethræ muscle when it is desired to irrigate the anterior urethra alone.

The solutions employed in the irrigating apparatus are bichloride of mercury 1 to 20,000, with one drachm of sodium chloride added for each pint of water; ammonium sulpho-ichthyolate 1 to 2000 to 500, in normal salt solution; potassium permanganate 1 to 6000 to 1000; protargol 1 to 10,000 to 2000; argyrol 1 to 2000 to 500.

The potassium permanganate solution is the one which is most popular and least irritating, at least in the early stages of acute gonorrhœa. This is used as hot as can be borne with comfort. The reservoir is filled and elevated to a height of two to three feet if the anterior urethra alone is to be irrigated, to a height of four to six feet if both the anterior and the posterior urethra are to be medicated.

The patient urinates, cleanses the glans, foreskin, and urethral orifice by turning the stream from the nozzle upon the parts, then inserts the nozzle, with the stream still flowing, into the meatus, the penis being drawn slightly upward and forward in about the position it would occupy if erect. The patient should sit on the edge of a chair with a basin so arranged that the solution which escapes is received in it, or, better still, should practise these injections while sitting on the seat of a commode or water-closet. When the anterior urethra is alone involved in the inflammation these irrigations should be limited to this part of the canal. The bag should be elevated two feet above the level of the bladder. The stream should be allowed to flow until a sense of distention in the bulb and involuntary muscular contraction in the perineum show that the anterior urethra is full and the compressor urethræ is excited to reflex contraction. The stream is then cut off, and the lotion contained in the urethra allowed to flow out. By starting the stream and applying the nozzle to the meatus the anterior urethra is again distended, and is emptied as before. This process is repeated until the bagful of solution has been used.

If the urethral inflammation is total, as shown by examination of the urine,—and this is nearly always the case,—the bag is elevated four to five feet, and the urethral nozzle is held in place with the water-pressure maintained until the compressor urethræ yields and a strong desire to urinate shows that the bladder is full. The nozzle is then withdrawn, and the patient empties the bladder of the solution which has flowed into it. This is repeated once or twice at each séance. For the first three or four days these irrigations are repeated twice in the twenty-four hours,—that is, morning and evening; after that once in twenty-four hours is sufficient, the strength of the solution being gradually increased in accordance with the tolerance of the urethra and bladder. The first injections should be made of a strength of 1 to 6000 permanganate, unless inflammatory action is severe, which will be shown by persistent pain and by swelling of the meatus. The solution is strengthened in the course of from seven to fourteen days till a lotion of 1 to 2000 is employed; stronger than this should not be introduced into the bladder. Exceptionally 1 to 500 may be employed in the anterior urethra.

When sublimate is employed the strength is gradually increased from 1 to 20,000 to 1 to 5000. Protargol is used in about the same strength as potassium permanganate.

Janet gives two tables of treatment: one for the abortive treatment of anterior urethritis, in which he begins with a strength of 1 to 4000 and on the eighth day finishes with a strength of 1 to 500; the second, in which he begins with the same strength, on the fifth day uses 1 to 1000 to the anterior urethra, 1 to 2000 to the posterior, and on the eighth day uses 1 to 500 to the anterior, 1 to 1000 to the posterior. He holds that 1 to 1000 is as strong a solution as should ever be used in the posterior urethra, since 1 to 500 employed here will produce painful tenesmus. In the first few hours following irrigation there is a whitish secretion, followed by clear serum, sometimes slightly blood-stained; then absence of secretion; finally, reappearance of purulent discharge, together with the gonococci. The return of purulent secretion is an indication that the effect of the irrigation has passed off: hence these washings should succeed one another so rapidly that this recurrent purulent discharge will be entirely prevented; that is, the second irrigation should be given during the dry period occasioned by the first irrigation.

As to the question of predicting a cure, this is difficult. Usually ten or eleven washings will be sufficient to bring about abortion. At this time there is no discharge and there are few or no shreds. Sometimes there is a little mucous discharge, especially if a strong solution has been employed. In this case irrigations are stopped, and the patient is advised to continue his observance of the hygienic directions, and told to report immediately on the first sign of white discharge. In the absence of this he appears eight days after the last irrigation.

If recurrence takes place, the discharge usually appears from the second to the fifth day after the last washing.

In case of recurrence the irrigations are again administered; sometimes two or three are sufficient, sometimes it is necessary to give the complete series. When the patients are cured, eight days after irrigation there will be found an uninflamed meatus, and entire absence of discharge and of shreds in the urine. For the next two months, however, such a patient will be especially susceptible to renewed infection.

Janet holds that permanganate has a peculiar action on the urethra. It occasions a slight œdema of the urethra; while this lasts not a single microbe can be found in the secretion. The success of the permanganate treatment seems to show that the microbes are so influenced by the alteration of their culture ground, dependent upon the œdema, that they cease to grow: hence, if this condition of the urethra is sufficiently maintained, the complete destruction of the microbes is sure. It therefore follows that for successful treatment it is necessary to keep the mucous membrane continuously in a certain condition of reaction. If the treatment is carried too far, the growth of the microbe is encouraged; if it is not carried far enough, inhibition ceases. This special reaction is fugacious in proportion to the acuteness of the gonorrhœa: hence the necessity for frequent repetitions of the injections. The special skill in treating this disease depends upon recognizing the required condition of reaction, and in so regulating the strength and the frequency of treatment that this condition is maintained for several days.

It is a matter of cardinal importance in applying these irrigations, and indeed in any treatment of gonorrhœa, to disinfect thoroughly any urethral crypts which may be found about the meatus. On separating the lips of the meatus these are readily seen opening at the superior commissure. They are practically always present in cases of hypospadia. They should be either thoroughly irrigated or cauterized, their deepest portions being reached by means of a fine stick of silver nitrate, or, better, with a hot needle. When they are narrow and especially deep, their canals should be divided freely, thus allowing of thorough cauterization. From the position of these crypts it is evident that unless they are searched for and treated directly they are liable to remain as sources of renewed infection, since the nozzle of either the syringe or the injecting pipe is carried beyond them, and they receive none of the antiseptic fluid.

When examination of the urine shows absence of clap-shreds, or, if these are present, shows that they are made up of mucus and epithelium, the irrigations can be gradually stopped, being administered every other day for six days, then every third day for six more days, then omitted entirely.

When there is continuance of mucous discharge, in the absence of gonococci and a notable quantity of pus, irrigations of silver nitrate or its newer organic salts are particularly serviceable. If, after complete cessation of treatment, there recurs a white drop made up of mucus and pus, irrigation should be resumed, and usually stops the discharge in a few days. If, after three weeks' treatment, discharge persists, astringent injections should be applied to the anterior urethra by means of a piston syringe, the posterior urethra being treated either by lotions or by instillations, according to the indications of the case.

The advantages of the irrigation treatment with dilute antiseptic lotions are, that the discharge lessens almost immediately, that the ardor urinæ and chordee are rarely intense, and that the disease in general runs a milder course and is less frequently and seriously complicated than is the case with injection treatment. Exceptionally the urine will be found free from clap-shreds in from twelve to fourteen days, there remaining for one or two weeks a slight moisture, which subsides spontaneously. This is particularly liable to be the case when the attack is seen early in its course and is not highly inflammatory in its type. It often happens, however, that the discharge, though quickly reduced to a morning drop of milky pus or to the morning gluing together of the lips of the meatus, undergoes no subsequent diminution; clap-shreds are found in the urine in the third and fourth weeks, and strong astringents are necessary to complete the cure. This is especially liable to occur when the disease has reached its acute stage before being subjected to irrigation, and when the urethra is already strictured by previous attacks of inflammation. In the former case judicious strengthenings of the solutions may accomplish cure; in the latter the use of bougies will be necessary to effect cessation of the discharge.

The disadvantages of copious flushings are, that each treatment takes about ten minutes for its proper performance, that a somewhat cumbersome apparatus is required, and one which it is difficult for the patient himself to employ unobserved, and that in some cases the irrigations are followed by persistent and very severe pain. It is also urged against them that it is at times impossible to limit their action to the anterior urethra, it being undoubtedly true that even when a soft catheter is used the steady, gentle pressure of the column of fluid will in a few minutes overcome the resistance of the compressor urethræ and sphincter vesicæ muscles and thus allow the lotion to flow backward into the prostatic urethra and the bladder. This is, however, not an objection, since the prostatic urethra is usually involved and requires treatment. As is true of every other method of treatment, these copious flushings are not suited to all cases. They give better results, however, than any of the single methods already described, and, although troublesome and time-consuming in application, tend to prevent complications and to shorten the course of the disease. During irrigation treatment the general hygienic directions and the medication by the mouth already advised should be employed.

It must be understood that irrigations are contra-indicated when they occasion severe and prolonged pain and when they are followed by marked inflammatory reaction.

Treatment of Acute Posterior Urethritis.—It may be assumed that in about ninety per cent. of all cases of gonorrhœa the posterior urethra is involved in the inflammation. Often this is not deep-seated, and occasions no special symptoms beyond tendency to priapism, which, though usually attributed to irritation of the penile urethra, is in reality a reflex from the posterior urethra.

When tenesmus, frequent urination, and pains in the deep urethra indicate that this portion of the passage is involved in a hyperacute form of inflammation, all exclusively local treatment to the anterior urethra, such as injections, should immediately cease. As much rest as possible should be enforced, the bowels should be moved daily by Hunyádi taken immediately on rising or by saline laxatives well diluted, the urine should be rendered copious and bland, and copaiba, cubebs, or other stimulants to the urethral mucous membrane, if they have been previously administered, should be discontinued.

Unless the stomach is disturbed by these drugs, salol or urotropin should be administered in five-grain doses four times a day. This at times seems to increase the violence of a posterior urethritis. In such a case boric acid should be administered instead, ten grains four times a day. The use of these antiseptics is most valuable in preventing the extension of the inflammation along the vasa deferentia or into the bladder.

General hot baths are particularly serviceable in acute posterior urethritis, giving sometimes immediate relief to the most distressing symptoms. If the tenesmus becomes so marked as to occasion acute distress, suppositories of opium and hyoscyamus should be administered, one grain of the aqueous extract of opium to one-fourth of a grain of hyoscyamus extract. These should be repeated hourly until the patient is completely relieved; four to six doses usually prove sufficient. In place of the suppositories hypodermics of morphine and atropine may be given; the needle of the syringe should be entered in the perineum.

Copious flushings of mild antiseptic solution are particularly serviceable in these cases. The solutions should, however, be so mild as not to add to the already existing irritation. Potassium permanganate is the solution of choice, beginning with a strength of 1 to 10,000. To hot permanganate solution is added common salt in the proportion of one drachm to the pint. Argyrol, ichthargan, and albargin, 1 to 2000 to 500, are also serviceable. The reflex spasm of the compressor urethræ muscle excited by the posterior urethritis is sometimes so great that it will not yield even though the reservoir be elevated six or seven feet above the level of the bladder; or when it yields the inflow of solution through the prostatic urethra may be intensely painful. In these cases the anterior urethra should be first flushed out, then, by means of the instillator introduced just within the grasp of the compressor, ten drops of a four per cent. solution of eucaine should be injected into the posterior urethra. Exceptionally even the weakest of these lotions seems to aggravate the violence of the inflammation. When this is the case they should of course be discontinued, and copious rectal injections of hot saline solution should be made by a two-way pipe, the stream being thrown upward and forward directly against the prostate.

In the hyperacute forms of posterior urethritis, when the pains and tenesmus are not controlled by free doses of morphine, the instillation of five to ten drops of a three to four per cent. solution of silver nitrate will often give almost immediate relief.

During the irrigation treatment the general hygienic directions and medication by the mouth already advised should be employed.

Résumé of the Treatment of Acute Urethritis.—1. Non-gonococcal urethritis may be treated by salol and boric acid, administered by the mouth. The urine should be kept bland. Recovery usually takes place in from seven to ten days; it may be hastened by unirritating, mild, antiseptic injections.

2. Acute gonorrhœal urethritis may be aborted sometimes if the infected mucous membrane receives twice daily permanganate irrigations and thorough applications of strong solutions of silver salts before the gonococci have penetrated too deeply.

3. The general treatment of urethritis is the same for all cases: rest, light diet, regular evacuation of the bowels, ingestion of bland liquids in quantities as great as is compatible with good digestion, abstinence from alcohol, from rich or highly seasoned foods, and from the excessive use of tobacco, avoidance of sexual excitement, hot baths at nights, drugs by the mouth calculated to diminish the acidity of the urine and to make it antiseptic, proper provision for receiving the discharge, and the treatment appropriate to ardor urinæ and chordee.

4. The local treatment is successful in proportion to the thoroughness with which mild antiseptics are applied to the entire diseased surface. The earlier in the attack their use is begun the more rapid and complete will be the cure.

Copious irrigations of hot, very dilute antiseptics are attended with most marked immediate improvement, but are not always able to prevent the case from running into gleet. These irrigations should be applied to the *entire* urethra.

Repeated flushings with piston or bulb syringe somewhat larger than the one usually employed, using the same solutions as are employed in copious irrigations, come next in order of efficiency during the increasing and stationary stage of gonorrhœa.

Single injections repeated through the day with the ordinary piston syringe have a less marked effect on the symptoms than either of the preceding methods during the increasing and stationary stages. During the subsiding stage they offer the most convenient method of applying stronger antiseptic and astringent solutions than are usually employed by the other methods.

5. In the choice of local medication, the increasing and stationary stages require a mild antiseptic; astringent action is useless. Since all antiseptics are irritating, the solution must be exceedingly dilute; it should be of about the same density as the blood-serum, and should be applied to the whole of the diseased surface,—*i.e.*, the entire urethra. In the subsiding stages stimulation by stronger antiseptics is allowable, and astringents for the relaxed mucous membrane are particularly indicated.

During the acute stage of posterior urethritis treatment of the anterior urethra alone should cease, local symptoms being subdued by copious flushings with very dilute antiseptic solutions, hot baths, and the administration of anodynes and sedatives. When the acute symptoms subside, the flushings may be with stronger antiseptic lotions, and may be supplemented by instillations with strong silver solutions.

6. Idiosyncrasies must always be considered in the choice of injections and in their strength. Changes must be made to meet individual cases, and in some rare cases all injections will have to be suspended, intra-urethral treatment not being tolerated.

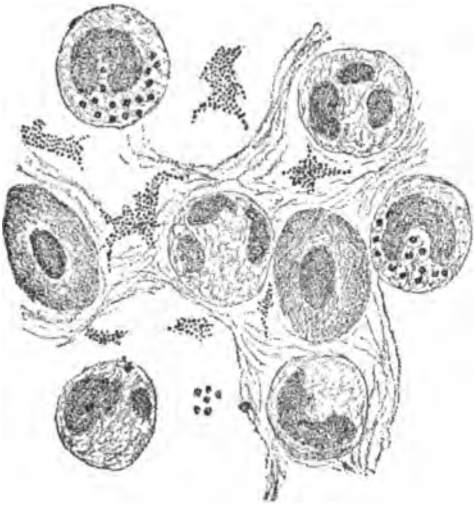
For irrigations and flushings, sublimate 1 to 12,000, potassium permanganate 1 to 6000 to 2000, and protargol or silver nitrate 1 to 2000 to 500, give best results. For injections the formula containing corrosive sublimate, carbolic acid, and boroglyceride (see page 135), varied in strength to suit each case, is particularly serviceable.

When astringents are required, the hydrastis-bismuth formula, silver nitrate, the injection Brou, or Ultzmann's injection, containing zinc, alum, and carbolic acid, will be found most serviceable.

7. Treatment must not be intermitted till pus disappears from the urine, and even then must not be stopped suddenly.

Subacute or Catarrhal Gonorrhœa.—This occurs most frequently in persons who have suffered from a previous attack of gonorrhœa, and exemplifies the tendency manifested by the mucous structures to become readily excited to inflammation from slight causes after having been once affected. This is particularly noticeable in the urethra, because this canal affords periodical passage for the urine, which, from changes in its constitution, may become a natural irritant. During erection it is exposed to intense congestion. On account of its excessive blood-supply and of the absence of firm extra-vascular support, the blood-vessels remain in an atonic condition and become greatly congested on slight provocation long after apparent complete recovery from an attack of urethritis. The close apposition of the mucous surfaces during the interval of micturition also favors the continuance of granular or congested areas or other traces of inflammation: hence but few who have had one attack of gonorrhœa escape subsequent manifestations, infection too feeble to overcome the resistance of a healthy urethra finding under such circumstances favorable soil.

Fig. 60.



Subacute gonorrhœa ; pus ; epithelium ; mixed infection. (Guyon.)

Symptoms.—In this form of gonorrhœa the incubation period is exceedingly variable (one to ten days), and there is often no inflammatory symptom beyond a profuse muco-purulent urethral discharge. There may be a slight feeling of warmth during urination and some increased sexual excitability, but ardor urinæ and painful erections are usually absent. A pure pus discharge is very rare, the latter being mainly mucous or serous. Gonococci and pus-cells are not abundant, but are found, together with epithelial cells, principally of the flat and transitional variety. (Fig. 60.) The inflammation seems to be purely superficial in its nature, and the disease is rarely attended by local complications. This form of discharge should be differentiated from that due to urethral syphilis. (See page 109.)

Under treatment the discharge rapidly diminishes in quantity until only a drop of mucus is found in the mornings; but this symptom is liable to persist for a long period, and is exceedingly difficult to suppress.

CHRONIC GONORRHŒA.

A purulent post-gonorrhœal discharge lasting more than ten weeks is indicative of chronic urethritis, or gleet. The essential, and often the only, sign of chronic urethritis is pus. This may be discharged from the meatus, particularly in the morning, or may be found only after careful examination of the urine.

Etiology.—Chronic urethral discharge—that is, the discharge which follows an acute or subacute gonorrhœa and persists—may be classed under one or more of the headings given on page 102. Thus it may be kept up by the results of trauma, particularly that due to irritating injections, causing persistent inflammation of the urethral follicles and Cowper's glands associated with gonococci.

Frequently repeated fresh infections are common and often unsuspected causes for the recrudescence of an apparently cured gonococcus infection.

Perhaps the usual cause of these acute exacerbations is incident to a neglect of treatment incident to the belief that the disease is so nearly cured that the irksome regimen of the systematic treatment is no longer needful. Excess in food or alcohol, exposure to cold and violent exercise render the urine irritating. Long-continued sexual excitement or constipation greatly increase local congestion. Thus the subsidizing inflammation may be rendered suddenly and violently acute from an apparently slight cause.

The cachexia associated with nephritis, hepatitis, diabetes, tuberculosis, or cancer may make the final cure of a discharge beginning as a frank gonorrhœa quite impossible.

A localized narrowing of the urethra, if it be due to a congenitally small meatus or valvular folding of the urethral mucosa or acquired inflammatory periurethral infiltration, may keep up a discharge indefinitely.

Irritating conditions of the urine, such as are found in oxaluria, phosphaturia, gout, rheumatism, and chronic indigestion, must be corrected before a gonorrhœa can be finally cured.

The usual causes of chronic anterior urethritis are folliculitis, stricture and chronic posterior urethritis.

Pathology.—The chronic inflammation is, at least in the early period of its course, dependent on the persistence of gonococci, which linger for a long time either in the diseased gland-ducts or follicles or in the deeper epithelial layers of the mucous membrane. These micro-organisms become weaker and less numerous in proportion to the length of time the disease has lasted, till finally they disappear entirely. The pus may be actively contagious as long as the gonococci are contained in it.

It is a safe rule to forbid coitus till repeated examinations made during periods of acute exacerbations have failed to demonstrate gonococci.

These micro-organisms exceptionally persist for two or three years.

Finger has shown that in the healing stage of urethritis the newly formed epithelium growing from the deeper layers towards the urethral lumen carries with it the gonococci and finally eliminates them all, provided there is no intercurrent acute inflammation. If, however, intercurrent inflammation occurs, the deep epithelial layer is broken through by the exudate, and by ways thus made the gonococci again force an entrance into the papillary layers and by their irritating action occasion renewed suppuration. From prolonged residence upon the same culture material these microbes gradually lose their virulence, and hence occasion progressively lighter recurrences, though, if conveyed to others, they may implant a severe form of the disease. Ultimately, even without antiseptic treatment, they disappear entirely. As a result of this lessened virulence after repeated recurrences and renewed penetration of the now feeble gonococci into the papillary layers, they may excite so little irritation here that scarcely any suppuration results, and hence the micro-organisms, not being eliminated, linger indefinitely.

The lesions of chronic urethritis appear as intense congestions, excoriations, granulations, epithelial thickenings, amounting at times to excrescences and papillomata, follicular and lacunar involvement, and infiltration of the submucous periurethral connective tissue, resulting ultimately in stricture.

The inflammation may be sharply localized or may be associated with a catarrhal condition of the mucous membrane involving considerable surface. It may be confined to either the anterior urethra or the posterior urethra; commonly both these regions are involved.

In the early stage of chronic urethritis there is an abundant round-celled infiltration of the urethral epithelium and subepithelial connective tissue; the epithelium overlying the inflammatory infiltrate proliferates and exfoliates, leaving catarrhal erosions. The lacunæ and follicles take part in this general catarrhal process, and as a result of epithelium proliferation may become blocked, folliculitis, or even abscesses, resulting. As organization and contraction of the infiltrate begin and the previously dilated blood-vessels are compressed, atrophy of the mucous membrane and its glands follows, the epithelium undergoing transformation from the cylindrical to the squamous form, varying in thickness in proportion to the density of the underlying scar-tissue. In the early period of its development this epithelium proliferates, and contributes to the formation of clap-shreds; later it becomes more firmly attached and horny in nature. When the cylindrical epithelium is transformed to the squamous variety it is no longer translucent, but becomes thick and whitish. According to Finger, erosions are very rare; ulcers he never observed. He frequently saw patches of infiltrated epithelium, thickened and pale in color, which resembled scar-tissue.

Morgagni's follicles, scarcely visible in the normal urethra, are, as a result of inflammation, converted into small projecting nodules, often with very distinct openings.

Finger concludes his study of the pathology of chronic urethritis as follows. Chronic gonorrhœa is essentially chronic inflammation of the subepithelial tissue, which passes through two stages,—namely, that of infiltration and that of connective-tissue formation and contraction. Together with this essential lesion there are proliferation, catarrhal desquamation, and mucoid degeneration of the epithelium of the urethra and of its lacunæ, also disease of Littre's glands and infiltrations of the cavernous tissue. Consecutive to these lesions the cylindrical epithelium is changed to the squamous form, the lacunæ are obliterated or blocked, and Littre's glands are destroyed.

The seat of predilection for chronic urethritis is the posterior urethra; the next favorite seat is the bulb, the whole of which is usually involved.

Diagnosis.—The catarrhal discharge dependent upon a weak and leaky mucous membrane and associated with no more serious pathological lesion than moderate congestion must be carefully distinguished from other post-gonorrhœal gleets, since in the former the discharge is bland and non-contagious, and local treatment, except by the mildest astringents, is distinctly contra-indicated. This condition may be termed urethral catarrh. After an acute attack of gonorrhœa has subsided and the last drop of muco-pus has disappeared, a patient suffering from this trouble will harass himself and weary his physician by complaining of a feeling of wetness about the meatus. Sometimes on stripping the urethra a drop of clear albuminoid fluid may be pressed out. Beyond this there are no symptoms other than those created by a worried imagination. The microscope will at once show the nature of the discharge. It will be made up of mucus and epithelium. There will be no pus, no gonococci.

Under general tonic and hygienic treatment this discharge will usually subside spontaneously in a few weeks unless the slight congestion is fanned to an active inflammation by irritating local treatment.

Acute gonorrhœa frequently runs into the chronic form of disease because of a general belief in the doctrine that the presence or the absence of the "morning drop" of muco-pus is the determining sign as to whether an acute gonorrhœa is or is not cured. Dependence on this untrustworthy sign leads to abandonment of treatment and restraint long before gonococci and pus have entirely disappeared. The strict regimen to which the patient has been subjected is often followed by excessive indulgence in previously interdicted pleasures. This results in renewed perceptible discharge. This again disappears on treatment, but is started by exposure even more readily than before. Finally the discharge becomes chronic.

Repeated examination of the urine will alone determine the presence or absence of discharge, and not until such examinations have shown pus to be absent for one or two weeks should treatment be entirely stopped.

To demonstrate the presence of the gonococci in chronic urethral discharge examinations must be made of the semen, the fluid expressed by prostatic massage, and the shreds in the urine. If a demonstration of their presence or absence is particularly important, this may be determined by adding to the chronic irritation an acute inflammation. This is best accomplished by injection of silver nitrate 1 to 2000. There follow an active hyperæmia and free discharge, in which the micro-organisms, stimulated to rapid growth by the abundant supply of pabulum incident to the acute inflammation and thrown off in the course of epithelial proliferation, may be found.

Chronic Anterior Urethritis.—The only symptom exciting attention in chronic anterior urethritis is the discharge. If this is slight and the focus of trouble is in the bulbous urethra, even this symptom may be wanting, the patient simply complaining of a sense of moisture about the meatus, or of the gluing together of its lips, in the morning. Usually a single whitish drop in the morning is all that is seen, micturition during the day washing away the muco-pus as fast as it is secreted, so that the patient is not required to wear cotton or other protection to prevent staining of the clothing. Coitus, drinking, or other excesses tend to exaggerate the discharge. After such causes for exacerbation it becomes more purulent in character and runs freely for a few days, when it again assumes the thin, whitish appearance characteristic of a predominance of mucus.

Clap-shreds are constantly found in the urine; these, when long, translucent, and branching, are mainly made up of mucus; when short, thick, and tack- or comma-shaped, they denote that the urethral crypts and follicles are involved.

Symptoms.—The characteristic symptom of chronic anterior urethritis is muco-purulent discharge. This varies greatly in quantity, from a free continuous running to a morning drop without further signs during the day, to a slight gluing of the lips of the meatus, or to no discharge whatever except that found floating in the urine in the form of clap-shreds.

The discharge varies in quality from thick yellow or yellow-green pus to thick muco-pus containing the micro-organisms of suppuration, or to nearly pure mucus containing a very few pus-cells and not showing the presence of gonococci. It is commonly intermittent, becoming frankly purulent and flowing freely after excesses or lapses from the irksome routine of methodic treatment, or without assignable cause, but quickly lessening in quantity under astringent injections till in a few days the discharge is about the same as before the exacerbation. This intermittence is misleading to the patient, since, on the one hand, it may convince him that he is well or nearly so when the disease is still active, and, on the other hand, it often leads him to suspect that he has acquired a fresh attack when symptoms are due simply to the stirring up of an inflammation so slight as not to have excited attention.

Discharge is usually the only symptom; occasionally there are intermittent ardor urinæ, neuralgic pains along the course of the urethra, and dribbling after urination.

Diagnosis.—This is founded on the discharge, and on the character of the urine passed in two portions, the first containing clap-shreds, while the last is clear; the first is also clear after flushing of the anterior urethra. The clap-shreds should always be examined for gonococci. This is done by spreading them on a cover-glass, removing the urine in which they float by means of blotting-paper, and then fixing and staining them in the ordinary way. (See page 115.)

Examination may be conducted by means of palpation, and by the use of the bulbous bougie or the urethroscope.

By palpation along the course of the urethra areas of tenderness and points of thickening may be felt. Polyps, or the circumscribed induration of a chronic folliculitis, may be detected.

Instruments should not be used till the disease is distinctly localized and chronic; then the bulbous bougies should be passed. The patient is first instructed to urinate; after he has done this a soft catheter should be passed to the bulbo-membranous juncture, and by means of a stream of weak bichloride solution (1 to 20,000) driven through it the anterior urethra should be washed free of discharge.

A thoroughly cleansed bulbous bougie as large as the meatus will admit should then be sterilized, well lubricated with carbolized glycerin, and gently introduced into the urethra. Points of special tenderness or of undue resistance should be noted. If the examination of the urine shows that the inflammation is confined to the anterior urethra, the bougie should not be passed beyond the bulbo-membranous juncture. The resistance of the compressor urethræ muscle and the distance from the meatus will show when it has reached this point. It should then be withdrawn. Pus and blood upon its shoulder will denote either erosions or an extremely congested condition of the mucous membrane. The seat of the lesion is often determined by the locality of the most severe pain attendant upon the introduction and withdrawal of the instrument, and in the later stages by an increased resistance to the passage of the instrument at that point. (See diagnosis of stricture, page 220.)

The urethroscope may be employed for the purpose of more exactly determining the locality and nature of the lesions and as a means of making strong applications to strictly localized inflammation, though it may often be dispensed with, the diagnosis being made and the treatment carried out with sufficient accuracy by the means already described.

Sometimes, though the rest of the urethra is healthy, an annoying discharge is kept up by chronic inflammation of the periurethral crypts opening at the borders of the meatus near the posterior commissure. In this case examination of the everted lips of the meatus will show the dilated opening, from which pus can be squeezed.

Prognosis.—In general terms the curability of gonorrhœa is in inverse proportion to its duration. In other words, the longer the disease lasts the deeper-seated it becomes and the more obstinate to treatment. Stricture is the usual sequel of chronic urethritis, and when once developed, even to the slightest degree, tends indefinitely to prolong urethral catarrh. The length of time during which the discharge of chronic urethritis is contagious cannot positively be stated. When, after repeated examinations of an artificially exacerbated discharge, no gonococci are found, it is fair to infer that none are present; yet it must be admitted that it is not safe to give an absolute opinion upon this point, since thus the physician takes upon himself the responsibility of permitting intercourse, which has in some few cases been followed by infection of the woman.

Treatment of Chronic Anterior Urethritis.—The most important points in the treatment of any chronic urethral discharge are (1) the restoration of the urethra to its normal calibre; (2) the cure of the general catarrh; (3) the healing of localized areas of inflammation.

A meatus of less than 24 F. should be cut. (See page 243.) Dilatation is accomplished by full-sized sounds, or, better, by a rubber-covered dilating instrument, which being introduced closed to the bulbo-membranous juncture, is opened to the proper calibre and withdrawn, thus milking the urethral crypts and follicles from behind forward. The Otis urethrameter or the prostatic dilator (page 163) answers well for this purpose. The urethra is then flushed with a mild antiseptic lotion,—protargol 1 to 2000 or ichthyol 1 to 1000,—and the patient is requested to appear for another treatment in two or three days. (See page 236.) In the mean time he uses daily either irrigations or the more astringent injections, and continues his general treatment. Salol and balsams are given by the mouth, the latter in full doses.

This treatment by sounding and irrigation is repeated every two or three days, in accordance with the severity of the reaction it excites, and is usually followed by cure in from two to six weeks. The pressure of a full-sized sound empties the follicles of their contents, sets up a reactive inflammation in the areas of infiltration, which is followed by absorption of the inflammatory infiltrate, and restores the tonicity of the over-distended blood-vessels. The first essential in the cure of the discharge is the restoration of the urethra to its normal calibre.

When urethroscopic examination shows localized areas of acute hyperæmia, or erosions, or infiltration and inflammation about the urethral follicles, or granular patches, or papillomata, or polypi, these lesions, though benefited by the introduction of the sound, are most quickly cured by direct application of strongly stimulating lotions. Such applications can be made only by means of a urethroscope. The lesion, having been exposed, is touched with a ten-grain solution of silver nitrate, or copper sulphate, or pure iodine, or a bichloride of mercury 1 to 100 solution, or an alcoholic solution of carbolic acid ten per cent., or Lugol's solution and carbolic acid equal parts of each. Applicators are conveniently made of split straws, barbed at the end to prevent the cotton wrapped about them from dropping into the urethra.

In the choice of these remedies, silver nitrate is most serviceable in the treatment of comparatively superficial catarrhal conditions not strictly localized, and particularly during the early stages of the chronic disease. In the beginning weak solutions should be tried, not stronger than two per cent. The strength should be gradually increased as the patient is able to bear it.

Inflamed follicles are treated by the application of the galvano-cautery needle, or of iodine and carbolic acid mixture. Granular surfaces do better under this latter remedy than under silver nitrate. The choice of the various remedies is, however, subject to no set rule. They should be changed or continued in accordance with the results they give.

Following the use of the endoscope, and sometimes following instrumentation, there are profuse discharge, sometimes bleeding, and usually ardor urinæ. After two days, especially when astringent injections, such as the alum, zinc, and carbolic acid mixture, are taken by the patient, the discharge disappears. These endoscopic applications are repeated not oftener than once in three or four days, and exceptionally cause prompt subsidence of discharge. Usually they have to be continued for several weeks before cure is effected.

Polyps or papillary outgrowths may be removed by curette, by caustics, or, best of all, when these growths are sessile, by the galvano-cautery applied through the endoscope.

In certain cases the use of the endoscope either does not better the patient's condition or distinctly aggravates the urethral discharge. Then, even though its use is apparently indicated by the nature of the lesions, it should be supplanted by other methods of treatment; preferably irrigation and dilatation.

Irrigations, particularly with solutions of full strength, are quite as valuable in chronic as in acute urethritis. The reason for their failure, and also for the failure of treatment by injections, is that chronic urethritis is rarely confined to the anterior urethra, and hence treatment directed to this portion of the passage alone fails to reach the seat of trouble.

Chronic Posterior Urethritis.—*Pathology.*—The pathology of chronic posterior urethritis is similar to that of long-standing inflammation of the anterior urethra. Finger states that from the first there is a round-cell infiltration of the subepithelial connective tissue, which subsequently undergoes organization and contraction. This infiltration is commonly superficial, though in cases of long standing it extends more deeply, involving the prostatic glands, the sinus pocularis, and the ejaculatory ducts, producing, in the stage of contraction, destruction of the lacunæ and superficial glands, and at times obliteration of the opening of the prostatic sinus and of the ejaculatory ducts. As a result of this infiltration of the subepithelial tissues, a catarrhal, often a suppurative, process is set up both on the urethral surface and in the prostatic glands and their ducts.

Symptoms.—The prostatic and membranous portions of the urethra are usually involved in cases of acute urethritis. This involvement is often so slight that it occasions no symptoms, not even undue frequency of urination, and is detected only by finding pus and the comma-shreds in the urine which has been evacuated after the anterior urethra has been thoroughly flushed by irrigation.

This chronic indolent catarrh is rendered subacute or even acute by very slight causes, such as exposure to cold, moderate drinking, or coitus. The inflammation then extends forward to the bulbous urethra, and there is a more or less free discharge, often associated with slight urgency and undue frequency in micturition. These symptoms subside quickly, and are usually attributed to a mild cystitis.

The anterior discharge disappears, and the patient considers himself well till some further imprudence causes these symptoms to recur.

When the inflammation extends deeper, involving the mucous membrane of the caput gallinaginis and the glandular and periglandular structure of the prostate, the symptoms usually become very pronounced. The nerve-supply of this region is exceedingly rich, and its relation to the genital system is so close that any decided change in the structure of the prostate is necessarily attended by well-marked local and general symptoms.

Tenesmus is perhaps the most frequent local symptom observed. This may appear simply in the form of increased frequency of micturition, or it may force the patient to make several efforts at urination, passing a small quantity each time before the sensation is relieved. The passage of hardened fæces, the pressure of the examining finger through the rectum, or the excitement of coitus may all occasion an intense desire to urinate.

Pain may be a pronounced feature in these cases. At times it is constant, deep-seated, burning, stinging, and peculiarly harassing. It sometimes radiates to the rectum and down the thighs, and is often greatly exaggerated by sexual intercourse.

Sexual weakness is a not infrequent sequel of chronic posterior urethritis. It may take the form of pollutions, impotence, prostatorrhœa, or rarely true spermatorrhœa.

Sexual neurasthenia is an almost invariable accompaniment of the deeper-seated chronic inflammation of the posterior urethra.

Diagnosis.—This is founded on (1) the repeated recurrence of purulent discharge after apparent cure and from seemingly insufficient causes; 2, clap-shreds in the second urine or the presence of unstained shreds in the urine passed after irrigation of the anterior urethra with staining solutions, such as methyl blue; 3, attacks of epididymitis, so-called cystitis, and prostatitis; 4, frequency and urgency of urination, either constant or paroxysmal; 5, symptoms of sexual neurasthenia.

The differential diagnosis between CHRONIC ANTERIOR URETHRITIS and CHRONIC POSTERIOR URETHRITIS may be summarized as follows (Finger):

Discharge from Meatus.—In comparatively recent cases of chronic anterior urethritis there is either a constant or a morning muco-purulent discharge. In old cases there is simply a constant or usually only a morning gluing of the lips of the meatus, or there may be no perceptible discharge.

Chronic posterior urethritis gives no discharge from the meatus.

Test of the Two Beakers.—Chronic anterior urethritis causes the first portion of urine to exhibit shreds and often slight cloudiness.

Chronic posterior urethritis if comparatively recent makes both urines slightly cloudy,—the first containing the ordinary stringy clap-shreds, the second often exhibiting Fürbringer's hooks (short, dense, comma-shreds, supposed to represent plugs from follicles or gland-ducts). Long-standing chronic urethritis does not cause cloudiness of the urine, but causes shreds to appear always in the first portion passed, often in both portions.

Test of the Two Beakers after Irrigation of the Anterior Urethra.—In chronic anterior urethritis both urines are clear.

In chronic posterior urethritis the appearance of the urine is the same as though the anterior urethra had not been irrigated,—*i.e.*, as in the test of the two beakers.

In chronic anterior urethritis the urethrameters or acorn bougies will show in old cases certain points of lessened dilatability. There will be no other symptoms, while in chronic posterior urethritis there are often tenesmus, prostatorrhœa, frequent micturition, spermatorrhœa, sexual irritation, increased desire, frequent pollutions, precipitate, often painful, ejaculation, feeble erection, impotence, and neurasthenia.

Prognosis.—The great majority of cases of posterior urethritis recover without direct treatment. It is, however, a rule with few exceptions that a gleet cannot be permanently cured as long as there persists a chronic inflammation of the posterior urethra, and where chronic urethral discharge is not due to the presence of well-developed stricture its dependence upon posterior urethritis must always be suspected. In some cases without treatment the inflammation lasts indefinitely, extending gradually deeper till irreparable damage has been done to the structure of the prostate or the ejaculatory ducts have become permanently blocked. At times the chronic inflammation seems to be the exciting cause for the development of genito-urinary tuberculosis.

Treatment.—The general hygienic and dietetic rules laid down in

Table of Differential Diagnosis.

	Acute Anterior Urethritis.	Acute Posterior Urethritis.	Acute Posterior Urethro-Cystitis.	Acute Non-Blennorrhagic Cystitis.	Phosphaturia.	Bacteriuria.
Secretion at the orifice of the urethra.	Abundant.	Less abundant and often contrasting with intensity of turbidity of the urine.	Slight and often contrasting with intensity of turbidity of the urine.	None.	None.	None.
Test of the two beakers.	First portion cloudy. Second portion always clear.	First portion very cloudy. Second portion cloudy, or clear and cloudy alternately: opacity always less than first portion.	First portion cloudy. Second portion always cloudy, difference in opacity of both parts not marked.	First portion cloudy. Second portion always more cloudy than first.	Both portions equally cloudy.	Both portions equally cloudy.
Test of the three beakers.	First portion cloudy. Second and third portions always clear.	First portion very cloudy. Second and third portions cloudy, or clear and cloudy alternately; cloudiness always less than that of first part.	First portion cloudy. Second portion always cloudy. Third portion very cloudy, usually more than first part.	First portion cloudy. Second portion like first. Third portion more cloudy than first and second.	All three portions equally cloudy.	All three portions equally cloudy.
Test of two beakers after irrigation of pars anterior.	Two portions clear.	First portion cloudy. Second portion cloudy, or alternately clear and cloudy; cloudiness always less than first.	First portion cloudy. Second portion more cloudy than first portion.	First portion cloudy. Second portion more cloudy than first portion.	Both portions cloudy.	Both portions cloudy.
Reaction of urine.	Acid.	Acid.	Acid.	Acid or alkaline.	Feebly acid or alkaline.	Strongly acid.
Microscope.	Secretion and sediment of first portion: pus-cells containing gonococci.	Secretion and sediment of both portions: pus-cells containing gonococci.	Secretion: pus-cells containing gonococci, also abundant bladder epithelium in sediment of both portions.	Sediment of both portions: pus-cells, bladder epithelium, no gonococci, numerous bacteria.	Amorphous granules, groups of crystals of calcium phosphate and calcium carbonate.	Numerous bacteria, few cellular elements.
Addition of acetic acid to the urine.	Cloudiness unchanged or increased.[1]	Cloudiness unchanged and slightly increased.[1]	Cloudiness unchanged or slightly increased.[1]	Cloudiness unchanged or slightly increased.[1]	Cloudiness clears.	Cloudiness unchanged.
Other characteristic symptoms.	....	Vesical tenesmus continuous or imperative; hæmaturia with last drops of urine.	Vesical tenesmus; hæmaturia (from the pars prostatica).	Coagula of pus in alkaline urine.	Very changeable, usually appears only once or twice a day.	

---

[1] It must not be forgotten that any one of the processes may be complicated with phosphaturia, in which case the addition of acetic acid produces partial clearing up of the urine.

the systematic treatment of acute urethritis should be enforced, though moderate indulgence in light wines during meals need not be forbidden unless liquors of all kinds are contra-indicated for other reasons. A sound digestion and regular movements of the bowels are particularly to be insisted on.

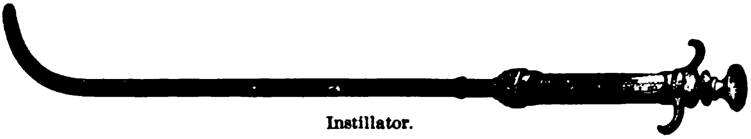
Balsams and antiseptics, such as copaiba, oil of sandal wood, and extract of saw palmetto should be administered by the mouth in doses not sufficient to disturb the stomach. The urine should be rendered bland and unirritating. Copious hot rectal douches will prove useful when bladder irritability or sexual neuroses are marked. Massage of the prostate is of value in long-standing cases. For the direct treatment there may be used irrigations, sounds, instillations, and ointments or suppositories.

Irrigation of the prostatic urethra should be preceded every third day by prostatic massage, since thus the crypts and follicles are emptied and are subject to the subsequent cleansing wash. Irrigation is practised by means of the short urethral nozzle and irrigating bag. Exceptionally the pressure necessary to overcome the resistance of the compressor urethræ muscle is painful and irritating to the anterior urethra. A soft rubber catheter may then be used, or, if the spasmodic action of the sphincter is too strong to allow the introduction of this instrument, an ordinary English catheter. This instrument is passed till its end is within the grip of the compressor urethræ muscle; then a hard rubber syringe is employed to throw in two ounces of a dilute antiseptic solution, such as 1 to 1000 argyrol or 1 to 2000 protargol, or 1 to 5000 potassium permanganate, or 1 to 1000 ichthyol, or a lotion representing corrosive sublimate 1 to 10,000, with carbolic acid 1 to 200. This flows back into the bladder. The catheter is then withdrawn until, the injection being continued, the fluid flows out from the meatus, when it is attached to a fountain syringe containing one or two pints of a hot dilute antiseptic solution, and the anterior urethra is flushed thoroughly, the whole contents of the bag being employed at each treatment. This injection may be accomplished without the intervention of the piston syringe, the catheter being attached directly to the irrigator introduced into the bladder and very slowly withdrawn after the stream is turned on until the back-flow escapes from the meatus. These treatments are repeated every day for two weeks, or until clap-shreds disappear from the urine, then every second or third day, being thus stopped gradually. When a given solution occasions distinct vesical irritability and increased urethral discharge, it should be weakened or changed. If it is well borne, it is gradually increased in strength up to 1 to 4000 bichloride, 1 to 500 protargol, or 1 to 1000 permanganate. Every third day, immediately preceding irrigation, a full-sized sound is passed.

If, after two or three weeks of these massages and irrigations or injections, the posterior catarrh continues, and particularly if there are some tenesmus and undue frequency of urination, the posterior irrigations are supplanted by instillations.

Instillations are made by means of a long catheter-nozzled syringe called an instillator. (Fig. 61.) This is a hard rubber or silver catheter, cylindrical in shape, eight inches long, provided with a short terminal curve, and having an extremely fine central channel. To the straight end of this catheter is secured an ordinary hypodermic syringe. The cross-bar at the top not only facilitates injection, but indicates the position of the curved end of the instrument. Five to twenty drops of the solution desired are sucked up into the syringe through the fine central tube of this catheter; the latter is lubricated, and is inserted until its end lies just within the grip of the compressor urethræ muscle. The solution is then driven in by pressure upon the piston of the syringe, and flows backward along the membranous and prostatic urethra into the bladder. If these injections are properly made, not a drop escapes into the anterior urethra.

Fig. 61.



Instillator.

These instillations require that the extremity of the instrument shall be carried exactly to the proper point,—*i.e.*, just within the membranous urethra. Usually it is easy to determine this point. It lies over five inches and under seven inches from the meatus, and is reached only when the shaft of the instrument is swept vertically upward from the belly wall and is carried downward between the legs till it makes an angle of about seventy degrees with the plane of the horizon. The compressor urethræ, at first resisting the passage of the instrument, on steady pressure rather suddenly yields, letting the extremity easily slip farther. Moreover the patient is aware of this sensation of yielding, and can notify the surgeon when it is felt, though by the former it may be wrongly attributed to the instrument entering the bladder. Often at the moment the end of the instrument passes within the grip of the compressor it causes a violent desire to urinate, though the sensation is more commonly associated with irritation of the prostatic urethra, and is immediately excited often to a most distressing degree when, after properly passing the instillator, the strong injection is driven in.

Exceptionally it is extremely difficult to determine just when the instillator catheter has been introduced to the proper depth. Thus the distance guide (five and a half to seven inches) may fail in cases in which the introduction of the instrument causes a condition of partial erection, or when the penis varies greatly from the normal extremes of size. The resistance of the accelerator urinæ may be mistaken for that of the compressor urethræ; this mistake will be avoided if it is remembered that the resistance of the accelerator urinæ is always encountered less than five inches from the meatus and usually less than four inches. The compressor urethræ may offer such slight resistance that it is not perceptible to the hand passing the instrument, or, if in a condition of reflex irritability and if associated with a capacious bulb, may resist so tightly as to prevent the engagement of the point of the instrument, which, when the handle is swept between the thighs, glides upward, yielding a false sense of progression and leading to injection into the anterior urethra. These mistakes may be avoided by measuring the distance from the meatus to the compressor by means of a full-sized bulbous bougie and marking this distance on the shaft of the instillator. In the absence of the sense of yielding usually experienced when the end of the instrument is held firmly against the compressor urethræ muscle, the instrument should be passed until its point is fixed,—*i.e.*, cannot be rotated from side to side, when the convexity of the curve is prevented from rocking by external pressure made by the fingers on the perineum.

The solutions employed in the instillation treatment are those of silver nitrate, copper sulphate, protargol, iodine and carbolic acid, and bichloride of mercury. The stronger the solution the fewer the number of drops to be employed.

The most valuable of all solutions in the treatment of chronic gonorrhœal urethritis is silver nitrate, beginning with ten drops of a one per cent. solution, repeating the application every third day, and running the strength up to five or even ten per cent. These instillations usually should be preceded by the passage of a full-sized sound and by an irrigation. Copper sulphate or iodine and carbolic acid, equal parts of one per cent. to ten per cent. solution, may be employed when silver nitrate is either ineffective or is followed by an undue amount of bladder irritability. In making these injections the bladder should contain a small quantity of urine, since thus any portion of the medicament which passes into its cavity will be at once diluted and, in the case of silver nitrate, neutralized. If the bladder is largely distended with urine, the medicament is diluted before it has thoroughly acted upon the whole of the prostatic urethra.

Instillations are particularly indicated when in addition to the discharge from the posterior urethra there are frequent or urgent urination, pollutions, pain during orgasms, constant or intermittent pain in the deep urethra, or any of the symptoms denoting deep-seated involvement of the prostatic urethra. Instillations are contra-indicated when the symptoms are acute in type; when examination of the urine shows that the discharge is profuse; when examination through the rectum indicates acute inflammation of the seminal vesicles; when even the weaker instillation lotions are followed by prolonged perineal pain, distressing tenesmus and frequency of urination, fever, pain in the testicles, or the discharge of blood at the end of urination. In tubercular cases the silver nitrate markedly aggravates the severity of the symptoms, this bad effect continuing for many days.

The effect of the instillation seems to be the substitution of an acute urethral inflammation for one which has become chronic and deep-seated, thus producing a condition of hyperæmia and of abundant exudate, followed by active processes of absorption of both the new and the old inflammatory exudates and a return to normal conditions. Occasionally they will relieve almost instantly the distressing tenesmus of acute urethritis.

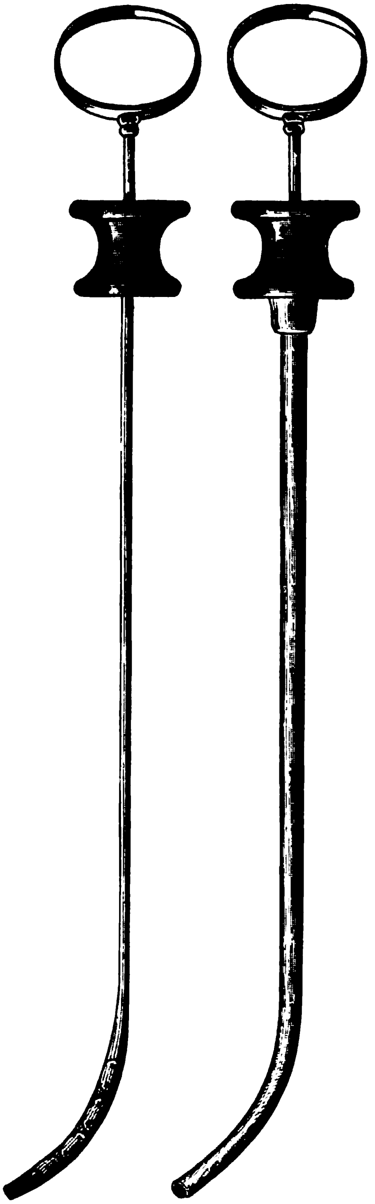
A mixture of iodine and carbolic acid, equal parts of each, is of service in inveterate chronic cases so sluggish that the stronger silver solution seems to have no effect.

Ointments, especially those made with lanolin as an excipient, are particularly commended by Finger as being more penetrating and more lasting in their effect than lotions. Ointments may be applied to the whole urethra by means of the sounds proposed by Unna. These are coated with the following mixture:

℞ Ol. theobrom., ℥i;
Ceræ flav., gr. x;
Argenti nit., gr. v;
Bals. Peruvian., gr. x.
M. S.—Melt over a water bath.

The sounds are covered with this ointment while it is warm, and are then hung in the air to cool and to allow of solidification of the ointment. When the sound thus coated is introduced into the urethra the heat of the parts melts the ointment, and thus the entire mucous membrane is medicated. In chronic cases associated with catarrh of the whole urethra this treatment is of value, since the effect of medication is enhanced by the pressure of the sound.

FIG. 62.



Tommasoli's ointment-carrier.

Ointments may be applied to the posterior urethra alone or to localized inflammations of the anterior urethra by a piston catheter so designed that the lumen of the instrument can be partly filled with the melted ointment, when by pushing the piston down as much as is desired can be forced out from the open end. By making the lumen of the catheter of a given diameter and by proper markings on the staff of the piston, the exact quantity of ointment deposited on any portion of the urethra may be known. The instrument of Tommasoli is among the best. (Fig. 62.)

The ointments of choice are:

℞ Creolin, ♏v to ♏xv;
Lanolin, ℥i;
Ol. olivæ, ℥ss.

Silver nitrate or copper sulphate, five to fifteen grains, may replace the creolin in this formula.

Or

℞ Potassii iodidi, ʒss;
Iodi pur., gr. v;
Lanolin, ℥i;
Ol. olivæ, ʒss,

or

℞ Ammon. sulph. ichthyolat., gr. xlviii;
Lanolin, ℥i,

may be used.

The application of these ointments should follow the passage of a full-sized sound.

Suppositories may be made of either gelatin or cacao butter. They are introduced by means of an instrument very like that employed for the application of ointments, except that the piston forms a close-fitting obturator for the introduction. This catheter is passed until the end has engaged in the grasp of the compressor urethræ muscle; the obturator is then withdrawn, and a suppository introduced within the lumen of the catheter and pushed into the prostatic urethra by means of the obturator. The medications of choice are practically those already given, silver nitrate being particularly serviceable; astringents and sedatives may also be administered in this way.

℞ Ext. hydrast., gr. v;
Iodoform., gr. ii,

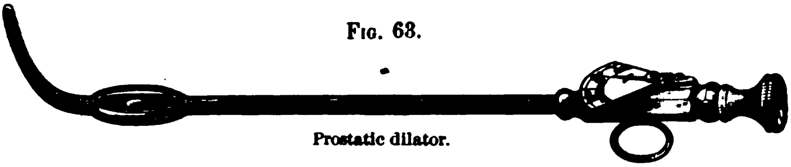
℞ Zinci sulphatis, gr. i;
Acidi carbolici, gr. i;
Morphin. sulph., gr. ¼;
Ext. belladonnæ, gr. ss;
Cocain. hydrochlor., gr. ss to gr. i

will be found among the most useful formulæ.

These suppositories are occasionally of service when the patient is compelled to conduct most of the treatment himself, since he can readily be instructed as to the proper application, and since they are less irritating than strong instillations, and hence, in case of improper administration, are less liable to do harm.

Pressure and cold water also are potent means of influencing chronic posterior urethritis, particularly when this has penetrated deeply and is rebellious to ordinary treatment. The pressure of a full-sized sound is serviceable and usually sufficient, but in the inveterate cases this will not answer, since the narrow membranous urethra does not allow of the entrance of a solid metal instrument sufficiently large to dilate the prostatic urethra. Under these circumstances the prostatic dilator (Fig. 63) applied at intervals of from seven to fourteen days will be found useful. This should be preceded by irrigation and followed by irrigation and instillation. The dilatation should be carried to not less than 32 F. and not more than 50 F., the sensation of the patient being a fair index as to the amount of stretching which is allowable. It should be gradual, five to ten

FIG. 63.



Prostatic dilator.

minutes being required for its completion, and intermittent, the dilator being run up to 34, for instance, maintained there a minute, and then loosened until the patient is entirely comfortable. After a little delay it is gradually screwed up to 36, and again loosened, finally perhaps 38 or 40 being reached, but not if the pain excited by slighter dilatations is extremely severe.

In the inveterate cases characterized by prostatorrhœa and the symptoms of sexual neurasthenia, the psychrophore may be serviceable. This consists of a full-sized hollow metal sound which can be kept at any desired temperature by a current of water flowing through it.

Summary of the Treatment of Chronic Gonorrhœa.—As a basis of treatment the seats of inflammation must be accurately located by palpation, sounds, bulbous bougies, and the urethroscope. Examination of the discharge as it flows from the meatus, and as it appears in the urine, shows approximately the inflamed area, indicates the extent of follicular involvement, and affords a means of determining whether the discharge is still contagious.

The inflammation is more deeply seated and more persistent in the bulb, the prostatic urethra, and the navicular fossa. It may be sharply circumscribed, but more commonly there is an extensive surrounding area of congestion and catarrhal discharge involving both the anterior and the posterior portion of the urethra.

Where there is free secretion containing much mucus and flat and transitional epithelium, irrigation is particularly serviceable in cutting down discharge and curing the general superficial inflammation. The irrigation, always immediately preceded by urination, should be made under strong pressure (five feet), and should include the entire urethra. Permanganate 1 to 6000 to 1000, silver nitrate or protargol 1 to 6000 to 500, corrosive chloride 1 to 20,000, zinc sulphate, carbolic acid, powdered alum, of each twelve grains to the pint, are the solutions of choice, and should occasionally be preceded by massage of the prostate and the passage of a dilating instrument or a full-sized sound, thus emptying the inflamed follicles and allowing the cleansing lotions to reach the deepest recesses of the diseased mucous membrane. The irrigation is repeated daily, the dilatation every third day. The strength of the solution is gradually increased as tolerance is established.

When by irrigation the inflammation has become circumscribed, or when there is spontaneous subsidence of the general catarrh but local lesions persist, direct applications of stronger astringent and antiseptic remedies to the seat of disease are indicated. These are made to the lesions of the anterior urethra through the urethroscope, to the lesions of the posterior urethra by the instillator.

The solutions of choice are silver nitrate one to ten per cent., solution of copper sulphate in similar strength, or of iodine and carbolic acid each two to ten per cent. in glycerin. These applications, which are confined strictly to the diseased areas, are preceded by the passage of a sound and by irrigation, the solution of choice being one of bichloride of mercury 1 to 10,000 in carbolic acid 1 to 200. The irrigation is repeated daily, the sounding every third day.

When irrigations cause severe and lasting pain or excite marked inflammatory reaction in spite of having been carefully weakened, or cannot be taken by the patient, injections with the ordinary piston syringe may be used. These cannot effectively reach the posterior urethra, and when this part of the urinary passage is involved must be supplemented by instillations, bougies, or ointments. The steel sounds or prostatic dilator should supplement injections once in three days. The injections are given from four to six times daily, and are held in the urethra for three minutes each time. The pain and tenesmus following vesical sounding, irrigation, and instillation are best relieved by opium and belladonna suppositories. The proof of cure of chronic gonorrhœa is absence of clap-shreds in the urine. Translucent, stringy shreds made up of mucus and epithelium will persist as long as treatment is kept up. The presence of these alone indicates cessation of local treatment. The general hygienic measures to be observed by a gleety patient are much the same as those described under acute gonorrhœa, except that exercise should be encouraged, and the taboo upon liquors need not be so absolute.

The first essential to successful treatment is restoration of the urethra to its normal calibre; this frequently necessitates meatotomy.

It is well to recognize the fact that certain exceptional cases of chronic posterior urethritis cannot be cured by active treatment. The source of discharge is in these cases beyond the reach of antiseptics or astringents, often in the ducts or dilatations of the prostatic glands or the prostatic sinus, the ejaculatory ducts, the ampulla of the vas, or the seminal vesicles. Applications to the surface of the prostatic urethra, if painful, set up an acute inflammation, which by blocking the ducts and orifices of already inflamed glands and follicles may cause abscess-formation. Moreover, frequently repeated irritation may produce a chronic inflammation of the greater part of the prostatic mucous membrane, with infiltration and thickening of the subepithelial connective tissue, thus greatly aggravating a condition which the applications are powerless to help. If after two months' treatment of a posterior chronic urethritis not associated with stricture there is no very marked improvement, and particularly if coincidently with active treatment the patient becomes worse, all applications and medication directed to the urethra, except, perhaps, massage of the prostate, should cease, and the patient should be given the hygienic directions best calculated to put him in good general condition. The ultimate prognosis under such circumstances is usually good. Often apparent cure quickly follows cessation of treatment.

Gonorrhœa of the male urethra, in accordance with its clinical course, may be classified as follows:

1. Mild.
2. Severe.
3. Neurotic or neuralgic.
4. Recurrent or relapsing.
5. Intractable.

Mild gonorrhœa is characterized by long incubation, moderate symptoms, absence of complications, and at times rapid cure, though the disease may be indefinitely prolonged. Treatment, both local and hygienic, should be carried out as faithfully as would be indicated for a more severe attack.

Severe or virulent gonorrhœa, vulgarly called "Russian Clap," occurs in those whose urethras are predisposed to inflammation by intense congestion, such as results from alcoholic and venereal excesses. It is also observed in healthy young men, who have never had a similar infection and who have practised ill-advised, irritating injections, in the hope of preventing gonococcal infection.

The period of incubation is short, the subjective symptoms are severe. The discharge is profuse and bloody, marked posterior urethral involvement occurs early. Blood-stained pollutions, ardor urinæ, often retention of urine, painful erections and chordee, harass the patient, who is still further weakened by fever due to septic absorption. Complications are common and troublesome. The course of the disease is usually prolonged. Treatment should be active, and stringent to the minutest detail. Rest in bed, diluents, a milk and butter-milk diet, hot sitz-baths and regular evacuations from the bowels are means best calculated to prevent complications and to hasten cure.

Neurotic (or neuralgic) gonorrhœa is characterized by hyperacute subjective symptoms, out of proportion to the amount of discharge. The irritable cases show excessive local pain. Injections and irrigations are intolerable, and often cause bleeding. Erections and chordee are frequent. Local tenderness is severe. For these cases full doses of bromide are indicated. Hyoscine hydrobromate, grain $\frac{1}{100}$, or Hyoscyamine sulphate, grain $\frac{1}{100}$, at bedtime will relieve chordee. Hygienic, dietetic and internal medical treatment must be stringent. Drugs stimulating to the mucous membrane, such as copaiba, and cubebs, must be omitted. Local injections and irrigations are contra-indicated until the subsiding stage.

Neurotic or Neuralgic Gonorrhœa is often associated with neurasthenia or even melancholia; there is a distrust of treatment and impatience at the slowness of results, with a tendency to try secretly every suggestion independent of its source. The discharge and local symptoms may be mild, but the disease tends to become intractable as a result of diversified treatment. Due consideration to the neurasthenic element should be given in the management of these cases.

Relapsing and recurrent gonorrhœa, if not due to reinfection, is usually incident to an almost symptomless chronic posterior urethritis. Exceptionally, a gonorrhœal Cowperitis or folliculitis is the cause. The treatment consists in finding and ablating the focus of the recurring urethral infection.

Intractable gonorrhœa is always due to a persistent lesion, usually a folliculitis associated after months and years with stricture formation. As a rule, it is observed in persons impatient of restraint, who before complete cure of an acute case revert to the excesses which were responsible for the original attack. The treatment of these cases is dependent on finding and eliminating the local lesion. A very small percentage of these cases is tubercular.

CHAPTER IV.

GONORRHŒA IN WOMEN.

Frequency of the Disease.—Leaving aside the consideration of harlots, practically all of whom suffer from some of the acute or chronic forms of the disease, gonorrhœa attacks a large number of reputable women. The gloomy Noeggerath states that eighty per cent. of women are affected with latent gonorrhœa, while Sänger, of nineteen hundred and thirty women coming to his clinic, found that twelve per cent. had this disease. Young married women become infected because long-standing gleet is not generally regarded as a possible bar to matrimony: hence men with chronic urethral discharge should at least understand that the gonococcus may persist and maintain its virulence for two or three years. Gonorrhœa in woman excites symptoms which even in their acute stage may not be attributed by the patient to any cause more serious than a cold, a strain, or some irregularity in her periodical sickness, and hence treatment is often neglected.

Seat of Infection.—In women, as in men, the urethra is most frequently involved in the gonorrhœal inflammation. Next in order of frequency comes the mucous membrane of the cervix, then that of the uterus, and finally that of the Fallopian tubes.

Vaginitis, at least that directly due to the gonococcus, is extremely rare, except in children, and possibly in young women recently deflowered.

Vulvitis is not uncommon, and is often accompanied by inflammation of the glands of Bartholin.

Contagion.—As in the male, gonorrhœa is acute or chronic. Though it is usually conveyed during sexual intercourse, the possibilities of mediate contagion through bathing-water, garments, towels, etc., are much greater in women than in men.

In girl babies the disease is nearly always acquired by mediate contagion. The discharge is derived sometimes from a gonorrhœal ophthalmia, generally from the genital tract of the mother. Only very exceptionally is the contagion immediate and from criminal practices.

Acute gonorrhœa is usually acquired from the discharge of an acute case, though there can be no doubt that chronic gonorrhœa in the male may excite a florid attack in the female. Gleety discharges, if contagious, sometimes gives rise to a subacute attack.

Symptoms.—The symptoms of acute gonorrhœa are at the beginning usually those of acute vulvitis and urethritis; in children and young girls there is also an acute vaginitis.

The patient complains of a sense of heat and burning about the genitalia, of profuse purulent discharge, of ardor urinæ, and of urgency and frequency in micturition.

If the uterine mucous membrane is also involved there are usually marked constitutional symptoms, *i.e.*, fever and depression, and, in addition, severe pains in the uterine region, swelling of the womb, and bloody purulent discharge from it. Not infrequently perimetritis complicates the uterine inflammation.

The involvement of the mucous membrane of the ovarian tubes may cause salpingitis and peritonitis.

An examination shows the mucous membrane of the vulva and sometimes that of the vagina infiltrated, reddened, and eroded. Pus can be milked from the urethra.

The subacute gonorrhœa sometimes acquired from chronic gonorrhœa of the male rarely shows itself by pronounced typical symptoms. There are intermittent attacks of slight ardor urinæ, frequency of micturition, disorders of menstruation, pelvic pains, and disturbances in the uterine function, manifested by dysmenorrhœa, by sterility, by abortion, and by attacks of perimetritis, salpingitis, ovaritis, or local or general peritonitis. The patients gradually lose their health, become unfit for work of any kind, and are prone to develop into typical neurasthenics.

On examination there will usually be found a catarrhal condition of Bartholin's glands and of the periurethral follicles. Purulent secretion escapes from the cervical canal, which is sometimes eroded. The uterus is found enlarged, tender on pressure, and fixed in its abnormal position from attacks of perimetritis. The ovaries and tubes are often enlarged, displaced, and fixed.

Diagnosis.—In the ordinary acute case this is not difficult, since the symptoms themselves are almost characteristic, and the detection of the gonococcus will at once settle the nature of the attack.

The subacute form is sometimes extremely difficult to diagnose, since the gonococcus may not be found. According to Sänger, in arriving at such a diagnosis careful search should be made for acute or chronic gonorrhœa in the husband, or a history of gonorrhœa subsequently cured. The presence of gonorrhœal ophthalmia in children is highly suggestive.

Matters of diagnostic import are: a history of uterine catarrh without obvious cause; disease of Bartholin's glands, and especially redness of the skin surrounding their ducts; the presence of condylomata; the discharge of muco-purulent matter from the cervix without erosions or pseudo-erosions of the os; disease of the adnexa or of the pelvic peritoneum. Without doubt many of these affections are due to other germs than the gonococcus, such complications representing a form of mixed infection.

URETHRITIS.

The urethra is nearly always involved in gonorrhœal infection, and the presence of inflammation in this canal is in itself presumptive evidence of the nature of the urethritis.

Acute Urethritis.—The acute stage of the disease is brief, and is accompanied by symptoms of moderate severity as compared with urethritis in the male. It is less liable to become chronic than is the case in men, or if it lingers it causes symptoms so slight that they are readily overlooked: hence the frequency of the involvement of the urethra in gonorrhœal inflammation is often underestimated.

Symptoms.—These are very much like those observed in men. The incubation period varies from a few hours to five or six days, and exceptionally is much longer. Slight tickling or burning sensations on urination, moderate purulent discharge, demonstrated by milking the urethra from above downward, and a swollen, œdematous urethral orifice are often the only symptoms which can be detected, though in specially sensitive women there will be at the beginning of the attack rigors, slight fever, and general malaise. In from a few days to two or three weeks even these symptoms disappear, and the disease is regarded as cured.

Finger believes, however, that it becomes chronic in women much more frequently than is the case in men, being subject to exacerbations, and often months after the original attack exciting a urethro-cystitis, the symptoms and course of which are much like those of the same condition in man, except that it is less severe and more amenable to treatment.

Chronic urethritis rarely excites sufficiently characteristic symptoms to suggest a probable diagnosis without a thorough examination. This should be conducted at a time when the patient has not urinated for several hours. Pressure on the urethra from behind forward may show that this tube is thickened and somewhat sensitive, and will usually press out a thin, milky, muco-purulent drop. In case there is not sufficient discharge for this, the vulva and vagina are carefully washed and the patient is requested to urinate in two portions. Clap-shreds and pus will be found in the first portion; if pus is discovered in the last portion, this is usually indicative of the presence of chronic cystitis.

An endoscopic examination in cases of acute urethritis in women shows redness, swelling, and general acute congestion of the mucous membrane. In the chronic cases diffuse redness, areas of epithelial thickening, and sometimes comparatively deep erosions are observed, the latter especially about the openings of follicles.

FOLLICULITIS.—As in the male, the urethra contains many follicles, and these are subject to gonorrhœal inflammation, forming small tender tumors which commonly evacuate their contents into the urethra.

There are two follicles which are particularly liable to become infected. These are situated in the lower urethral wall and open just within the external urethral orifice. A fine probe can be inserted into the duct of each to a depth of from one-half to three-fourths of an inch. When these follicles are acutely inflamed and their urethral openings firmly blocked, the softening and breaking down may cause urethro-vestibular or urethro-vaginal fistulæ.

In addition to these two deep follicles there are a number of smaller ones situated about the meatus. Many or all of these may become inflamed, rendering the urethral opening unsymmetrical. They often rupture into the urethra, but again fill up and continue to discharge intermittently.

The frequency with which these follicles are involved in gonorrhœal inflammation makes diagnosis particularly important. A careful examination usually shows at once the true nature of the case, since immediately after the urethra has been washed clean by the act of urination pressure causes exudation of pus. Moreover, on direct examination the inflamed openings of the follicles can generally be found.

Diagnosis.—The diagnosis of acute urethritis is dependent upon the symptoms and on finding the gonococcus.

If after holding the water for several hours no pus can be milked from the urethra, the vulva and vagina should be washed free of discharge. The patient should then micturate immediately, and the urine should be carefully examined for pus.

Prognosis.—The prognosis of urethritis is in women much more favorable than in men. The disease lasts for but a short time; the chronic forms of it occasion no trouble and usually undergo spontaneous cure without producing serious or permanent alterations in the urethral mucous membrane.

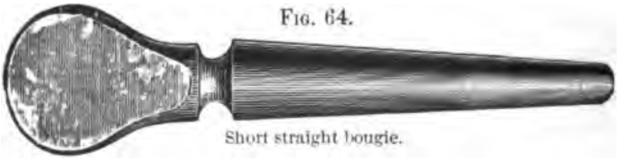
Treatment.—The treatment of acute urethritis in women is conducted on the same principles as govern the management of this disease in men. The diet is regulated, and the urine is rendered unirritating by the administration of potassium citrate or sodium bicarbonate and an abundance of water.

Balsams may be given from the first, and as soon as the acute symptoms subside injections are employed. These should be driven in by the ordinary clap syringe, but not more than a drachm should be injected at one time. The solutions employed are those used in the male urethra, but may be slightly stronger. As soon as the acute stage is past the lesions are located by the urethroscope, and are treated directly by means of iodine two to ten per cent. solution in glycerin, or silver nitrate one to ten per cent., these drugs, of course, being applied only to the inflamed spots by means of cotton tampons.

Chronic urethritis in women is usually dependent upon folliculitis, either the paraurethral glands about the meatus or a group of follicles near the neck of the bladder being involved. Destruction of the follicles by a finely pointed stick of silver nitrate or the electric needle when they are accessible, or, when the inflammation is placed near the bladder, the use of the endoscope for the application of iodine or silver nitrate, is indicated in these cases.

Exceptionally true stricture forms, usually at or near the meatus. The symptoms are frequent micturition, slight dribbling, and gleet, though the latter is rarely noticed. The fact that stricture may result from gonorrhœal inflammation of the female urethra would suggest a search for this condition in cases of functional urinary difficulty in women. The diagnosis is readily made by means of the bulbous bougie. Narrowing at or very near the meatus may require division, the knife cutting backward. Gradual dilatation will prove efficient for all other cases not traumatic. Straight metal bougies are employed running up to 40 F. (Fig. 64.)

FIG. 64.



Short straight bougie.

There is one form of chronic urethritis much resembling in symptoms the posterior urethritis observed in men. The patient complains of frequent urgent urination, tenesmus, and reflexes, such as vaginismus and backache, and a general condition of neurasthenia. On urethroscopic examination the mucous membrane at the neck of the bladder—*i.e.*, within the grip of the vesical sphincter—is found greatly thickened and congested or even fissured.

The treatment consists in wide dilatation (40 to 50 F.) and the application of strong solutions of silver nitrate.

VULVITIS.

Inflammation of the vulva is characterized by œdematous swelling, redness, and erosions affecting the greater and the lesser lips, and by a profuse purulent, irritating, extremely fetid discharge. This discharge coming in contact with the neighboring skin produces a dermatitis, which may pass backward towards the anus or downward along the inner surfaces of the thighs. There are constant itching and burning about the vulva, which become aggravated to severe pain by walking or motion of any kind involving the lower half of the body. Trickling of the urine over the abraded surfaces occasions much burning. Involvement of the inguinal glands is by no means uncommon.

Usually vulvitis has a tendency to spontaneous recovery. Occasionally, especially in children, it becomes chronic, persisting in the vestibular glands, and not only in those about the urethra, but also in those placed at the inner surface of the lesser lips. These chronically inflamed glands cause practically no symptoms, and are detected only by direct examination. Hyperæmic or eroded spots may be found overlying the swollen glands, which can sometimes be felt as small nodules; condylomata are frequently observed.

Treatment.—Cleanliness will usually accomplish cure, which is hastened by the employment of antiseptic and astringent lotions and by protecting inflamed surfaces from contact with the urine. In the acute stages the treatment consists in irrigation with very hot saline solution containing 1 to 6000 bichloride of mercury, practised twice a day, or more frequently if the discharge is free. Each irrigation is followed by the insertion between the greater and the lesser lip on each side of a thin sheet of cotton dipped in dilute lead water. This cotton should be changed every two or three hours. As the symptoms subside the inflamed parts should be painted once daily with a one per cent. solution of silver nitrate, and the irrigation should be followed by the use of a cleansing and astringent dusting powder and dry cotton.

BARTHOLINITIS.

Inflammation of Bartholin's glands is perhaps the most frequent complication of vulvitis, though even this is exceptional. It may be either acute or chronic. Whether it be due to infection of these glands by gonococci or by the ordinary pus microbes, the clinical fact remains that it is so rarely associated with non-gonorrhœal forms of vulvitis that if it occurs it is almost pathognomonic of gonorrhœa.

Acute Bartholinitis.—Acute inflammation of these glands develops suddenly, either during the fulminant stage of acute clap or long afterwards, from lighting up of the chronic inflammation by sexual excess or other cause.

There appears in the posterior third of the greater lip, usually on one side alone, though sometimes on each side, a tender, hard, very clearly outlined tumor about the size of a hazel-nut. This is soon followed by an œdematous swelling of the greater lip, sometimes extending to the lesser lip, and often as far forward as the prepuce of the clitoris. In place of a distinctly outlined tumor there develops a dense inflammatory infiltration, forming an extremely tender, painful swelling, often as large as a pigeon's egg, the surface of which is red. Shortly fluctuation is detected, suppuration being denoted at the same time by the constitutional symptoms of pus-formation.

The pus may break through the capsule of the gland, the overlying skin remaining intact. In this case it is apt to burrow backward along the perineum, forming extensive sinuses, and even opening into the rectum. Usually the skin also ulcerates and the pus is evacuated on the inner surface of the greater lip. This pus is blood-stained and foul-smelling.

Chronic Bartholinitis.—Chronic inflammation of Bartholin's glands may appear as an inflammation of the gland-ducts alone, the most frequent form, or may involve the gland substance. In the latter case hard nodules are felt on palpation, and on pressure a purulent fluid containing gonococci can be forced from the ducts. When the ducts alone are infected no induration will be felt on palpation, and on inspection nothing is seen except an area of hyperæmic, or possibly eroded, mucous membrane around the duct opening. Pressure may cause a small drop of purulent fluid to exude. Sometimes a large quantity of this fluid can be squeezed out, owing to retention from blocking of the duct. Not infrequently this duct is the only mucous surface in which the gonococci still survive: hence in an examination to confirm the presence or the absence of gonorrhœa the condition of Bartholin's glands and their ducts must always be most carefully investigated.

Treatment.—The treatment of the acute inflammation in the early stages before there is pus-formation consists in putting the patient to bed, keeping the bowels open, and applying evaporating lotions, constantly renewed. Of these, lead water and dilute alcohol are perhaps the best. As soon as fluctuation is detected, or when the constitutional symptoms denote pus-formation, the pus should be evacuated by a free incision made on the inner surface of the greater lip. The cavity should be curetted, washed with 1 to 1000 bichloride solution, and packed with iodoform gauze. This packing must be repeated frequently, and the cavity must be made to heal from the bottom.

Chronic inflammation is extremely difficult to cure. When the gland is involved and appears as a hard, slightly tender, circumscribed tumor subject to occasional attacks of subacute inflammation, the whole gland should be dissected out. If the ducts alone are involved, the catarrhal process may be cured by astringent and antiseptic injections carried in by means of a hypodermic needle blunted at the end. Usually, however, it will be necessary to split the duct thoroughly, scrape it, and pack with iodoform gauze until healing takes place.

METRITIS.

Acute metritis develops in the course of acute urethritis, vulvitis, or vaginitis. It is characterized by rigors and fever, pain in the hypogastric and sacral regions, generally aggravated by motion, and a discharge from the cervix, at first muco-purulent, then frankly purulent. On examination the womb is found to be tender and enlarged, and the cervix is swollen, œdematous, and often eroded.

The inflammation may be limited to the cervical mucous membrane. More commonly it involves the entire endometrium, and it may extend to the perimetrium, tubes, ovaries, and peritoneum.

Diagnosis.—The diagnosis is founded on the coexistence of urethritis, bartholinitis, etc., and on the discovery of the gonococcus.

Prognosis.—The prognosis as to complete cure must be guarded, since the disease has a tendency after subsidence of acute symptoms to linger indefinitely.

Chronic metritis, according to Finger, is acquired from the discharges of a chronic gonorrhœa of the urethra or external genitalia of the woman, the uterus having escaped during the acute stage of the disease, or is implanted by a male suffering from gleet. This form of metritis is the one commonly observed in young married women infected by their husbands.

Symptoms.—The inflammation is ushered in by a muco-purulent discharge, which excites little attention, since it is attributed to cold, defloration, excess, or other apparently sufficient cause. The discharge becomes profuse at times, and is especially free after the menstrual period. Gradually menstruation becomes painful and irregular and the flow is scanty; at the same time there is a deterioration in general health, with a sense of weight and dragging about the uterus, and the patient becomes neurotic and unfit for work.

The course of the chronic inflammation is varied by intercurrent subacute attacks, somewhat simulating acute metritis.

On examination a swollen, tender uterus is found, from which is discharged muco-pus. The gonococci can rarely be discovered in this discharge.

Diagnosis.—The diagnosis of chronic gonorrhœal metritis is extremely difficult. A preceding history of acute gonorrhœa, a venereal record on the part of the husband, or infection of others by the discharges, would strongly suggest the causative agency of the gonococcus in producing this inflammation.

Prognosis.—This form of inflammation has little tendency towards spontaneous cure; rather it extends slowly, particularly in the direction of the tubes and ovaries, producing sterility and chronic invalidism, and in many cases ultimately destroying life.

Gonorrhœal salpingitis and oöphoritis—an extension of the gonorrhœal inflammation to the tubes and ovaries—is not characterized by any pathognomonic symptoms. Menstruation is usually irregular, profuse, and very painful, intercurrent attacks of pelvic peritonitis occur, and there is often a rapid loss of health. All these symptoms are also observed in endometritis.

The tubes may be filled with pus, and this pus may escape into the uterus or may make a way for itself into the bowel, the case thus recovering spontaneously, or it may ulcerate through the tube or escape by its fimbriated extremity and occasion a fulminant form of peritonitis.

With involvement and obliteration of the tubes the ovaries are nearly always diseased, first a parovaritis developing, followed by atrophy and cyst-formation of the ovary.

Diagnosis.—The diagnosis of gonorrhœal salpingitis and ovaritis must be founded on bimanual examination, preferably with the patient well relaxed by ether.

Perimetritis.—The acute form of perimetritis is more prone to develop during pregnancy or after childbirth. The symptoms are those of acute pelvic peritonitis and septic absorption,—*i.e.*, pain, tenderness, vomiting, and fever,—and may terminate fatally in a few days. More commonly resolution takes place, even though there is apparently a large exudate. This Sänger considers typical of gonorrhœal infection.

The recurring form of perimetritis is due to pus-tubes; the symptoms are those of acute local peritonitis, and are most severe and lasting during the first attack. In the intervals the woman may enjoy perfect health.

The chronic form is characterized by persistent pain and tenderness. Every strain or jar is unbearable, coitus is not possible, and there is usually a marked condition of neurasthenia.

Treatment.—Gonorrhœal cervical endometritis should be treated first by thoroughly cleansing the vagina with antiseptic douches, 1 to 2000 bichloride (hot). The cervix is then exposed and its endometrium cleared of the viscid mucus which coats its surface by means of cotton tampons. Finally, the whole diseased surface is touched with one of the following solutions, named in the order of their efficiency: 1, silver nitrate ten per cent.; 2, tincture of iodine; 3, copper sulphate ten per cent.

Small cysts found in this form of inflammation should be punctured, and when there is marked congestion local depletion is indicated, the cervix being scarified by means of a long-handled knife.

When the inflammation resists these milder forms of treatment, a thorough curetting, followed by the application of zinc chloride, twenty per cent. solution, and by packing with iodoform gauze, will be indicated.

Endometritis involving the body of the womb should receive no direct treatment during the acute stage. Rest in bed, local depletion from the cervix, free action on the bowels by salines, and, when pain is very intense, the administration of an anodyne, represent the safest and most efficient treatment in this stage. When the disease has become chronic, the uterine cavity should be washed with hot bichloride solution 1 to 10,000, passed in through a two-way uterine irrigator. Large quantities of this fluid should be employed, one or two quarts at a time, and the treatment should be repeated every second day. If the disease still lingers in spite of this treatment, the cervix should be dilated, and the uterus thoroughly curetted, swabbed with a ten per cent. solution of zinc chloride, and packed with iodoform gauze. When the disease has extended to the parametrium, tubes, ovaries, and pelvic peritoneum, causing the local and general symptoms of acute pelvic peritonitis, free movements of the bowels, prolonged hot baths, and hot vaginal douches are indicated until the acute stage has passed and very definite localizing symptoms point to the use of the knife.

VAGINITIS.

Inflammation of the vagina, at one time regarded as the most characteristic manifestation of gonorrhœa in the female is now recognized as occurring much less frequently than urethritis or endometritis. The many layers of squamous epithelium are usually sufficient to prevent penetration of the gonococci. When, however, the vaginal mucous membrane is succulent and the spaces between the epithelial cells are widened, as in infants and children, or in young virgins, the gonococci may penetrate deeply and produce a true vaginitis. The vaginal inflammation sometimes noted in older women is often due to the irritating effect of decomposing discharges which flow from the endometrium.

Symptoms.—A sense of weight and burning in the vagina, aggravated by motion, a free purulent discharge, and slight fever and malaise are the only symptoms of which the patient complains. An examination shows the vaginal mucous membrane reddened, œdematous, and freely suppurating, and its walls somewhat stiffened by recent inflammatory exudation. The epithelium is eroded in places, and there are observed extensive granular patches, especially in pregnant women. Often there is so much tenderness that examination either by the finger or by the speculum is impossible.

Diagnosis.—This is founded on ocular and digital examination showing an acute inflammation of the vagina, usually associated with urethritis and vulvitis, and often with endometritis. The gonococcus may be found.

Prognosis.—In itself gonorrhœal vaginitis is not a serious affection. It is usually cured in two or three weeks. Exceptionally it becomes chronic, and in prostitutes causes a stiffened, dry, rough condition of the mucous membrane, termed xerosis vaginæ.

Treatment.—This should be cleansing and antiseptic. Twice a day the vagina is flushed out with two quarts of normal saline solution (seven-tenths per cent.) containing 1 to 4000 corrosive sublimate. This douche is best given from a fountain syringe raised two to four feet. During its administration the patient should lie on her back, with the hips slightly elevated, or, better still, should assume the knee-elbow position. When there is a bath-tub these flushings are easily managed.

After each washing the vagina is packed with a cotton-wool tampon dipped in hydrastis-glycerin mixture 1 to 10, or with iodoform gauze, thus keeping its walls from coming in contact and acting as mutual poultices; the packing also, by its astringent action, rapidly reduces the discharge.

When the acute symptoms have subsided, a speculum is introduced, and the inflamed and granular patches, or the entire vagina if all its surface is involved, are painted with ten per cent. silver nitrate solution. This is repeated in three days if necessary. Tincture of iodine may be used in place of the silver nitrate. In cases seen early, or where the inflammation is not so acute that insertion of a speculum is very painful, the silver nitrate painting is indicated from the first.

In chronic cases, irrigation, followed by paintings of the vagina with strong solutions of silver or copper ten per cent., or iodine pure, and then by tamponing with iodoform gauze, is repeated daily for from five to seven days; then dilute antiseptic washes are employed once daily for two weeks till epithelial regeneration is completed. Suppositories of tannin and boric acid (ten grains of each) inserted twice daily will greatly lessen the discharge, and will sometimes cure a chronic inflammation when other means have failed.

GONORRHŒA IN CHILDREN.

Male Children.—The course of gonorrhœa as observed in male children is not markedly different, in symptomatology, duration, or treatment, from the disease as it occurs in adults. It is a rare disease, at least in boys under twelve years of age, in this respect affording a marked contrast to gonorrhœal vulvo-vaginitis observed in the opposite sex. The cause is usually an attempt at intercourse, often suggested by a much older female. Very exceptionally the contagion may be mediate by means of fabrics or by foreign bodies previously infected being introduced within the urethra. When the disease develops in boys over twelve years of age it is usually acquired in the ordinary manner.

Symptoms.—These are the same as have been already described. They develop more quickly after exposure to contagion, and run a somewhat more acute course than is customary in the adult, the whole penis usually being swollen, the discharge being profuse, and the child complaining bitterly of the pain incident to micturition and erection.

Complications.—Of these the most frequent is balanoposthitis, incident, no doubt, to the phimosis usually present in children and to the vulnerability of the mucous coverings of the glans and foreskin. Indeed, other complications are rare, though a number of well-authenticated instances of epididymitis are reported. Hyperacute posterior urethritis and urethro-cystitis are by no means exceptional. There is usually pronounced fever.

Diagnosis.—This is founded on the presence of the gonococcus. Since it has been shown that in the normal urethra there are micro-organisms identical in all respects with the gonococcus, identification of these micro-organisms under the microscope is not a proof of the specific nature of the affection in medico-legal cases, though for clinical purposes it can be considered sufficient. When, as often occurs, there is a probability of cases coming to court, the specific nature of the affection should be proved by cultivation of the gonococcus on artificial blood serum. The growth is said to be absolutely characteristic and to differentiate satisfactorily this micro-organism from all others.

The search for the gonococcus should always be made, since simple irritative urethritis is by no means uncommon in children, and is in the beginning of its course not to be distinguished clinically from true gonorrhœa. This simple urethritis is often excited by the introduction of foreign bodies, by a simple balanoposthitis, and by the irritation incident to the passage of highly condensed urine.

It is usually mild and of short duration, contrasting with the inflammation resulting from the presence of the gonococcus.

The *prognosis* is favorable, the discharge usually ceasing in from three to six weeks. In weak, strumous, cachectic children it is liable to last much longer and may run into gleet. Stricture has been observed as a sequel.

Treatment.—This consists in rest in bed, the relief of phimosis by operation, circumcision being performed if the parts are not too greatly swollen, light diet, hot baths, the administration of laxatives when required, and medicines calculated to subdue the fever, render the urine bland and slightly antiseptic, and control the painful erections. These indications should be met by aconite in small doses, boric acid, and potassium bromide. An excellent formula for a child of five years is the following:

℞ Potassii bromidi, ʒii;
Acidi borici, gr. xlviii;
Tinct. aconiti, gtt. vi;
Tinct. belladonnæ, gtt. xxiv;
Spts. ætheris nit., fʒiii;
Mist. potassii citratis, q. s. ad f℥vi.
M. S.—Dessertspoonful in water every two hours.

The penis should be kept wrapped in cloths wet in lead water and dilute alcohol.

On the subsidence of the acute inflammatory symptoms injections may be administered. These should contain the remedies used in similar conditions of the adult, but should be somewhat weaker, varying from one-half to two-thirds strength, according to the age of the child. They should never be used strong enough to cause acute or prolonged pain. It is well to begin with the following injection:

℞ Ext. opii aq., gr. vi;
Acidi carbolici, gtt. xv;
Liq. plumbi subacetat. dil., f℥vi.
M. S.—Use locally.

Later an antiseptic and astringent injection, as the following, should be employed:

℞ Hydrarg. chlorid. corros., gr. $\frac{1}{30}$;
Acidi borici, ʒi;
Zinci sulpho-carbolat., gr. xii;
Liq. hydrogen. peroxid., f℥ss;
Aquæ rosæ, f℥vss.
M. S.—Use locally.

These injections should be administered immediately after the child urinates, from half a drachm to a drachm being thrown in each time. As soon as the fever subsides the internal administration of salol is serviceable. This may be given in doses of one to three grains six times a day, depending upon the age of the patient, and may be combined with balsam of copaiba or oil of sandal wood in appropriate doses. When the fever persists and assumes an irregular intermittent type full doses of quinine night and morning will be found serviceable.

Female Children.—In female children gonorrhœa takes the form of urethro-vulvo-vaginitis. It is different from the disease as it appears in the adult, since in the latter the vagina is only exceptionally involved.

There are two distinct forms: 1, catarrhal or irritative; 2, gonorrhœal.

CATARRHAL VULVO-VAGINITIS may be caused by any irritant, such as prolonged contact of irritating urine or of fæces, lack of cleanliness, seat-worms, decomposing discharges incident to exanthemata, etc. The inflammation is usually confined to the vulva, the vagina being but slightly involved, and the urethra escaping entirely.

The *symptoms* are those of ordinary inflammation, as heat, redness, swelling, pain, or itching, increased by contact with urine. There are often extensive excoriations, or even distinct ulcers.

The *diagnosis* is founded on the absence of gonococci and on the presence of vast numbers and varieties of other micro-organisms, the comparatively mild course of the affection, though it may be extremely chronic and rebellious to treatment, and the absence of involvement of the urethra and vagina. The prognosis is good.

The *treatment* consists in removal of the cause and in strict local cleanliness. Since this affection is very commonly associated with seat-worms, these should always be searched for. Mild antiseptic washes, as boric acid, followed by dusting powders, such as finely powdered bismuth or zinc oxide, and the application of a thin layer of cotton between abraded and inflamed surfaces,—*i.e.*, between the greater and the lesser lip of each side,—usually result in cure. When the disease becomes chronic, stronger astringent injections and washes are required.

GONORRHŒAL VULVO-VAGINITIS.—This is an affection which recent studies have shown to be much more prevalent and serious in its ultimate effects than has generally been believed.

Cause.—In the new-born and in young infants gonorrhœal vulvo-vaginitis is acquired from the mother, either from direct contagion during parturition, or from mediate contagion later through the agency of towels, wash-rags, fingers, etc. When it develops after the nursing period it is usually due to mediate contagion. Thus, it has been shown that when one case is introduced into an institution the disease spreads rapidly, probably by the medium of the bath or towels. The genital mucous membrane of the child seems to be exceedingly sensitive to the gonococcus. Exceptionally vulvo-vaginitis is caused by criminal practices. When these are suspected, and consequently when there is a possibility of a medico-legal contest, the presence of the gonococcus should always be confirmed by culture on artificial media.

Symptoms.—These are pronounced. The discharge is free, purulent, often blood-stained. It comes from the urethra, vagina, and vulva. There are great swelling, intense hyperæmia of the mucous surfaces, which bleed readily when touched, pronounced ardor urinæ, and marked and persistent fever. There is often bitter complaint of severe abdominal and pelvic pain. On rectal examination the womb may be found tender and swollen.

The *diagnosis* is founded on the presence of gonococci, the involvement of the urethra, and the severity of the symptoms.

The *prognosis* is good. None the less cases of peritonitis and death have been reported, and on the basis of apparently clear clinical records it has been shown that this inflammation in infancy may occasion imperfect development of the genitalia, sterility, and chronic invalidism in later life. The local conditions are apt to be rebellious to treatment.

Treatment.—Special care must be taken to guard against transference of the inflammation to the eye. This is peculiarly liable to happen in public institutions. The child should be put to bed, and given a milk diet, the bowels should be opened regularly, and a hot bath administered night and morning. Three times daily a small soft rubber catheter should be introduced into the vagina, and there should be gently injected first four ounces of a one per cent. hot solution of sodium bicarbonate, then the same quantity of a weak hot antiseptic, such as bichloride of mercury 1 to 20,000, carbolic acid 1 to 200, boric and salicylic acids ten grains of the former and five grains of the latter to the ounce, or protargol 1 to 5000. After this irrigation the vulva should be dried carefully with moist absorbent cotton, and dusted with a powder made of boric acid, zinc oxide, and talc equal parts, and between the labia should be inserted a thin layer of absorbent cotton.

If these injections cause pain they must be weakened until they are borne well. As the acute stage passes they are gradually strengthened, hydrastis being added. For the accompanying urethritis small doses of salol and boric acid are indicated, or the prescriptions given on page 135 can be advantageously used.

The general health should receive careful attention, and in strumous or cachectic patients treatment may have to be prolonged for weeks or months before cure is effected.

CHAPTER V.

COMPLICATIONS OF GONORRHŒA.

In the large majority of patients suffering from urethritis, when treatment has been judiciously instituted from the beginning of the attack there are no complications; that is, the disease is limited to the urethra and remains superficial. Exceptionally the inflammation exhibits a tendency to extend wide of the urethra or even to attack other parts of the body. In these cases there is usually mixed infection, the ordinary pus microbes being present and producing either local inflammations or a mild or even severe form of septic poisoning, though there is evidence that the gonococcus in itself or the ptomaines engendered by it may produce many of the complications which are encountered in these inflammations.

There seems to be a personal susceptibility towards the development of such complications, since certain patients never have the good fortune to run through a simple uncomplicated attack.

As to the cause of complications, in general terms it is true that all factors which tend to exacerbate an attack of gonorrhœa predispose to complications.

The fact that these complications are usually due to mixed infection is one which should be borne in mind as indicating the necessity for perfect cleanliness in all local manipulations.

The complications most frequently encountered in the male are: 1. Balanitis and balanoposthitis. 2. Phimosis and paraphimosis. 3. Lymphangitis and lymphadenitis. 4. Folliculitis and periurethral abscess. 5. Cowperitis. 6. Prostatitis. 7. Vesiculitis. 8. Epididymitis.

The complications common to both the male and the female are: 1. Cystitis. 2. Ureteritis and uretero-pyelitis. 3. Gonorrhœal conjunctivitis. 4. Gonorrhœal rheumatism, including such manifestations as arthritis, endocarditis, and meningitis.

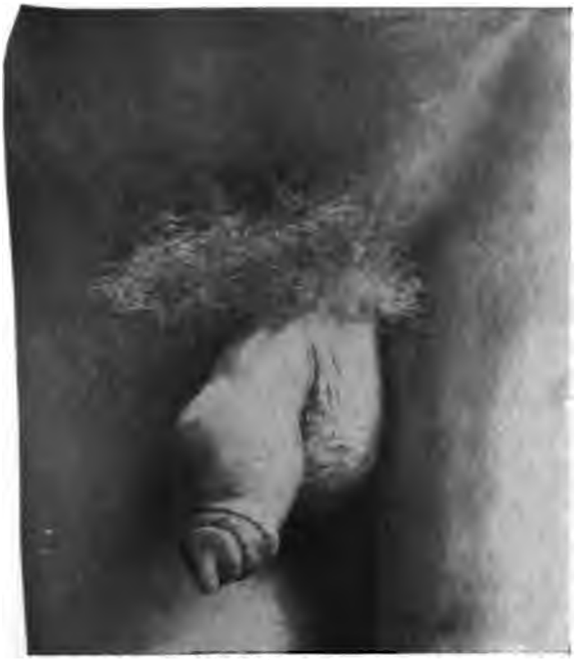
In men the most frequent complication is epididymitis.

Balanitis and Balanoposthitis.—Though gonococci seem to play no causative *rôle* in the production of balanitis, or inflammation of the surface of the glans penis, this is a frequent complication of gonorrhœa.

The symptoms, diagnosis, and treatment have already been described, the gonorrhœal form of the affection running a course which does not differ from that due to other causes. (See page 31.)

Phimosis, inflammatory in character and secondary to balanoposthitis, has already been described (see page 8). This is always a troublesome condition, since it materially interferes with treatment and may render the diagnosis exceedingly difficult. Swelling may become so great that a certain amount of sloughing occurs. The inflammatory induration usually entirely disappears. It may remain, leaving a thickened prepuce, which is readily fissured and eroded.

Fig. 65.



Gonorrhœal phimosis.

If the patient first comes under treatment with a vague history and with an œdematous swollen prepuce from the orifice of which blood and pus flow, it is sometimes difficult to determine correctly the source and nature of the discharge.

Whether or not all the discharge comes from the preputial sac or a part of it from the urethra can be ascertained in this way. The preputial sac is thoroughly washed out by means of a syringe to which is attached a soft rubber catheter small enough to pass within the preputial orifice, and immediately after this washing the patient is directed to urinate. If the urine contains much pus, the latter must come from the urethra.

Chancroidal balanitis can be suspected only from the development of bubo, the rapid and progressive swelling, and the free discharge, and from auto-inoculation, other sores forming on the free border of the preputial opening, or on the scrotum or other portions of the body with which the discharge comes in contact. The main points of difference between gonorrhœal and chancroidal phimosis may be summed up as follows:

Phimosis from Gonorrhœa.	*Phimosis with Preputial Chancroid.*
No history of sore on glans or prepuce. Swelling in foreskin at first almost entirely œdematous.	History of sore. Swelling often due to presence of plastic lymph around ulcer.
Discharge usually purulent, and contains gonococci.	Discharge often sanguinolent; no gonococci.
No definite area harder or more tender than the rest.	Distinct spot usually discoverable by palpation.
Chordee often present.	Never any true chordee.
Ardor urinæ extends along whole length of canal.	Ardor urinæ only when the urine comes in contact with the inflamed or ulcerated foreskin.
Vesical symptoms not infrequent.	No vesical symptoms in uncomplicated cases.
Bubo rare.	Bubo common.

Phimosis and balanitis from chancre may be diagnosed by the typical induration of the primary sore and by the characteristic lymphatic involvement and subsequent development of secondary symptoms.

Phimosis and balanitis due to secondary or tertiary manifestations of syphilis may occur. The diagnosis will in the first case depend upon the existence of typical eruptions in other parts of the body. The tertiary manifestations may be suspected from the history of the case. The mode of onset is usually characteristic of syphilis, a lesion appearing in the form of an infiltration or a hard node and preceding the development of phimosis.

The symptomatology and treatment of inflammatory phimosis have already been discussed.

Paraphimosis.—This, as is the case with phimosis, is dependent upon inflammatory swelling of the foreskin, which, after rolling back or being forced back, can no longer be brought forward. The question of differential diagnosis is scarcely raised here, since the urethral meatus is freely exposed and the discharge can be seen escaping through it. The treatment has been described. (See page 18.)

Lymphangitis.—In a small percentage of gonorrhœal cases a simple lymphangitis or inflammation of the lymphatic vessels occurs as a result of local infection.

This is often caused by neglect of cleanliness, the discharge being retained within the fossa navicularis either by a congenitally narrow meatus or by a faulty method of dressing. (See page 28.)

Lymphadenitis or Bubo.—Adenitis of the glands of the groin, or bubo, is a comparatively rare complication of gonorrhœa. It occurs chiefly during the second stage of the disease.

It is commonly excited by excesses, exposure, or violent and long-continued exertion. Persons who are much on their feet suffer more frequently from this complication than those whose occupation allows of more rest. The gland usually affected is one of the superficial set lying just below Poupart's ligament, embedded in the subcutaneous cellular tissue and placed above the fascia lata.

Symptoms.—A small, painful tumor makes its appearance in the groin; it is tender on pressure, and the pain is aggravated by standing or walking. It is at first freely movable beneath the skin, but afterwards contracts adhesions to the latter and to the surrounding parts, and becomes doughy in feel and reddened or purplish in hue. The majority of these cases after reaching this condition will subside under appropriate treatment, disappearing in time. In some instances, however, particularly in patients of scrofulous tendencies or in those whose vitality is lessened through bad habits or overwork, suppuration ensues, ushered in by the local and general phenomena of abscess-formation. The discharge from a suppurative gonorrhœal bubo does not contain gonococci.

Treatment.—Gonorrhœal bubo can often be relieved without suppuration by prolonged hot baths, followed by rest in bed, the application of the iodine, mercury, and belladonna ointment over the inflamed region and the use of a bag of hot shot containing two to four pounds placed directly over the inflamed part.

If suppuration takes place, the treatment should be that directed in the case of chancroidal bubo,—*i.e.*, puncture under antiseptic precautions and evacuations of the contents of the abscess, followed by antiseptic flushings of the sac and the application of a sterile dressing held in place by a pressure bandage. This puncture, evacuation, and washing out may be repeated twice. If the cavity again fill up, free incision, curetting, and packing with iodoform gauze are indicated. (See p. 57.)

Complete removal of gonorrhœal buboes before they have broken down is justifiable, provided they become progressively worse in spite of one or two days' careful treatment.

Follicular and Periurethral Abscess.—Gonorrhœal inflamn tion not only spreads along the surface of the urethra, but, dipping i the mucous follicles and gland ducts, involves their entire mucous s face. Often if the finger is passed along the under surface of the u thra there can be felt distinct nodulations, due to the follicular swelli At the meatus, where the glands and follicles are especially well dev oped, pus may be seen to escape from their orifices on pressure.

If the ducts become closed from swelling or from inflammat exudation, the catarrhal secretion of the follicles being no longer a to escape into the urethra, small pockets of pus, or follicular abscess appear. These follicular abscesses are most frequently located in first inch of the urethra, the follicles being numerous in this regi They appear as small, round, tender nodules, which may open int nally without involving the skin, the duct finally becoming patulo Frequently, however, the skin reddens and is no longer movable o the nodule, and the latter discharges its contents externally. In case the urethral opening of the gland usually remains closed, no fistula results, even though the frænum be completely undermi by suppurating follicles on each side. The frænum itself is apt to markedly œdematous during the period of pus-formation in the licles lying near its point of attachment behind and below the meat On stripping back the foreskin the projecting swelling is readily s entirely obliterating the normal depression situated at the side of frænal attachment. When external rupture and discharge of pus t place, there is often left a troublesome sinus.

Sometimes the lacuna magna remains in an inflammatory con tion long after the urethral mucous membrane has returned t healthy state. The opening of this follicle is so large that it is readily obliterated, yet it may be narrowed to such an extent t healing injections do not penetrate to its deeper portions. Such inflammation will occasion a long-continued discharge.

At the frænum the mucous follicles are surrounded by fibr tissue: hence this limits abscess-formation. Farther back along urethra this investment of connective tissue is less marked: he the inflammation may readily extend into the cavernous tissue, a in case the inflammation goes on to suppuration, periurethral absc will be formed.

Periurethral abscess begins as a case of folliculitis or adenitis, the swelling rapidly increases, and is attended with pain, tenderne and often some diminution in the size of the stream passed dur urination. The swelling may suddenly subside from opening of obstructed duct. This probably will be denoted by diminution in t size and tension of the tumor, by blood and pus in the urine, and by a sense of relief from pain. The subsidence may inaugurate a speedy cure, or, if the urine enters the abscess-cavity, may be shortly followed by urinary extravasation. Commonly the skin becomes reddened and inflamed, and the pus is evacuated externally, after which the abscess-cavity heals.

If the abscess opens externally and internally at the same time, a urinary fistula results, and one difficult to cure.

Periurethral abscesses occur at any portion of the anterior urethra, but are most frequently observed in the region of the bulb. They may be attended with considerable inflammatory induration of the corpus spongiosum, which may ultimately undergo complete resolution, or may remain permanently, constituting an incurable chordee and preventing intercourse.

When urinary extravasation occurs it is attended by rapid increase in pain and swelling, and infiltration of sometimes the greater portion of the corpus spongiosum. The local pain is much increased during each urination. There is commonly an opening formed externally, which allows of free purulent discharge and results in urinary fistula. Sometimes an extensive sloughing process is inaugurated, attended with well-marked general septic symptoms. Even in the mildest case of urinary extravasation there may be sufficient destruction of the erectile tissue of the spongy body to cause great deformity of the penis when the organ is erect.

Treatment.—Gentle pressure and massage are sometimes successful in rendering patulous the obstructed duct of an inflamed gland or follicle. When the swelling becomes marked and painful, cloths wet with alcohol and dilute lead water should be kept about the penis. When the skin becomes adherent and softening occurs, the follicles should be opened, curetted, and packed with iodoform gauze. They usually heal kindly from the bottom. When they have ruptured spontaneously, causing a troublesome sinus, this should be converted into an open wound, and be curetted and packed. When there are both an internal and an external opening, the formation of a permanent fistula is guarded against by permanent or intermittent catheterization, no urine being allowed to escape through the artificial opening. Fistulæ at times heal spontaneously. If not, a plastic operation is indicated.

When the lacuna magna becomes involved in a chronic inflammation, which, though not going on to abscess-formation, persists and keeps up discharge, a fine grooved director should be passed to its deepest part, and it should be slit out into the urethra.

Periurethral abscess when once formed demands immediate eva uation, and this indication is even more imperative when there urinary extravasation. The formation of a fistula is guarded again by permanent catheterization.

Prostatitis.—After the gonorrhœal inflammation has reached i full development in the prostatic urethra—that is, during the thi week of the attack or subsequent to this time—it may extend into t substance of the prostate gland. The involvement of the prosta occurs in but a small percentage of cases, and is at times observ when the posterior urethritis is so slight as to have given rise to marked symptoms. The follicles and glandular elements of this bo are chiefly involved, the muscular tissue, forming the greater porti of its mass, remaining unaffected, except in the most severe cases.

Simple acute prostatitis represents the mildest form of acute pro tatitis. It is probably present to a minor degree in every case acute posterior urethritis, and represents little more than inflamm tory hyperæmia.

Acute follicular prostatitis is usually due to some cause exciti renewed intensity of gonorrhœal inflammation, such as excessi drinking or coitus.

The patient complains of burning during urination, and sha shooting, clearly localized pains during the passage of the last dro These pains are located in the deep urethra. On rectal examinati the prostate is found to be not materially enlarged, but presents o or two well-defined nodules, usually in one lobe only. These intensely indurated, contrasting markedly with the soft condition the remainder of the gland, and are painful on pressure. The infla mation is confined to the follicles and the perifollicular tissues.

Parenchymatous prostatitis, after it runs on to suppuration, is most serious form of the affection. The whole structure of the gla is involved. There is not only great inflammatory hyperæmia, also marked exudation. The constitutional reaction is pronounced.

The abscess usually ruptures into the urethra. This will be noted by aggravation of the pain during the act of defecation or micturition, followed by a free discharge of blood and pus through urethra, and the immediate amelioration of all the symptoms. T is considered the most immediately favorable, and is the comm termination; it may be followed by urinary extravasation, requir operation, but this is unusual.

The pus may penetrate the capsule of the gland at any point. it is not evacuated into the urethra, it is prone to rupture into rectum. If it does not open into either the rectum or the urethra generally burrows into the perineum or the ischio-rectal fossa. It may burrow in almost any direction, cases being recorded in which it opened through the sciatic foramen, at the edge of the false ribs, and into the abdominal cavity.

At times prostatic abscesses develop in so quiet a manner as to escape observation. There are no symptoms other than those commonly noted in the congestive form of the disease; these are so slight that the patient makes no complaint. After some days the symptoms of septic absorption, characterized by rigors and fever, set in; and examination by the rectum shows a large fluctuating swelling or prostatic abscess. Hence in all cases of urethritis attended by undue systemic disturbance, examination should be made to discover whether or not this insidious form of prostatic trouble is developing. (For symptoms, diagnosis, and treatment of prostatitis, see page 726 et seq.)

Vesiculitis.—Vesiculitis, or inflammation of the seminal vesicles, occurs as a complication of acute posterior urethritis in a much larger percentage of cases than is generally imagined, the symptoms differing so slightly from those of inflammation of the prostate that the involvement of the seminal vesicles is not suspected unless a rectal examination is made. (See section on Seminal Vesicles, page 714.)

Epididymitis.—From an anatomical consideration of the ejaculatory ducts, vas deferens, and epididymis, it is easy to understand how by direct continuity inflammations of the prostatic urethra may travel to the epididymis.

Epididymitis rarely develops before the third week of gonorrhœa. Most of the cases begin in the fourth or fifth week of the disease. It may occur within three days of the onset of urethritis or not till a gleet has run a course of several years.

It is due primarily to involvement of the posterior urethra in the gonorrhœal process; secondarily, to any cause which, by increasing the violence of this inflammation, may favor its extension to the ejaculatory ducts and the vas: neglect of treatment, venereal excitement, coitus, exposure to cold, drinking, and violent exertion, all the causes which aggravate posterior urethritis, also render more probable the onset of epididymitis. Irritating anterior injections during the acute stage of a posterior urethritis frequently cause epididymitis. Of all these causes those commonly operative are neglect of treatment and coitus.

The disease is usually unilateral, and seems to affect the two sides with about equal frequency.

In accordance with the rule governing gonorrhœal inflammations,t induration of the epididymis is likely to be formative rather than supp rative ; hence, abscess is rare. (See section on Epididymitis, page 64

EXTRAGENITAL AND SYSTEMIC GONORRHŒA.

Extragenital **gonorrhœa,** as a rule secondary to urethral infecti in the same individual, exceptionally affects structures other th the genital tract, by predilection those covered with columnar epitl lium and endothelium, as the rectum, peritoneum, synovial sheat meninges, peri- and endocardium, blood-vessels, and pleura. Thou stratified pavement epithelium resists for a time gonococcal invasi gonorrhœal cystitis, conjunctivitis, and stomatitis are exceptiona observed.

Cystitis.—Until the nature of posterior urethritis was clea defined it was common to attribute the symptoms attendant u this inflammation to involvement of the neck of the bladder. T possibility of extension of posterior urethritis to the vesical muc membrane cannot be denied, and any one of the many causes wh aggravate the original disease may occasion such extension. T inflammation does not spread far from the internal orifice of urethra, being usually limited rather sharply to the trigone. In great majority of cases it is due to mixed infection, the gonococci the selves apparently not readily infecting the mucous membrane of bladder. Involvement of the entire vesical mucosa is extremely r The subjective symptoms are so like those of posterior urethritis t on these alone a differential diagnosis can scarcely be made. (chapter on Cystitis, page 416.)

This condition is difficult to cure, pathological alterations tak place in the vesical mucosa, and, indeed, in the whole thickn of the bladder walls, which are liable permanently to cripple viscus.

The general treatment appropriate to acute posterior urethr and to prostatitis requires no material alteration when it becon clear that the vesical mucosa is involved in the inflammation.

Ureteritis, Pyelitis, and Nephritis.—These complications rare, and can scarcely occur unless there is previous vesical dise as the result of urethral stricture, enlarged prostate, or other obst tive cause. The use of medicaments which produce acute hyperæ or congestion of the kidneys and their excretory apparatus predisp to extension of inflammation in this direction, as do all factors wh tend markedly to increase a posterior urethritis and cause it to volve the mucous membrane of the bladder, as, for instance, rough untimely instrumentation. Usually only one kidney is involved, and this sometimes without alteration of the ureter, although the latter is commonly found dilated and with thin walls,—in other words, exhibiting the effect of backward pressure. In the early stage of the affection the inflammation involves only the mucous membrane of the renal pelvis. This may be followed by hydronephrosis from blocking of the ureter and consequent atrophy of the kidney, or may extend into the kidney substance itself, producing either parenchymatous or interstititial nephritis.

The disease often undergoes resolution, particularly when it is comparatively recent, and when the cystitis and posterior urethritis which precede it have been cured and the urethra is no longer obstructed. (For symptoms and treatment, see these subjects.)

Gonorrhœa of the Rectum.—Gonorrhœal inflammation of the rectal mucous membrane is observed more frequently in women than in men, mainly because women are more exposed to infection from the backward trickling of gonococcus-bearing secretions from the vulva and vagina. The disease can be excited by unnatural practices.

Symptoms.—The symptoms are those of acute inflammation. There are free discharge of blood-stained pus, tenesmus, painful defecation, and on direct examination acute redness and infiltration of the mucous membrane, with excoriations about the anal orifice. The disease is prone to become chronic, leaving on subsidence of the general inflammation one or more localized ulcers. These, if allowed to extend, may ultimately cause dense cicatrices.

The *diagnosis* is, of course, founded upon the presence of the gonococcus, together with a history of infection.

The *treatment* consists in relieving the tenesmus and burning pain of the early stages, in frequent cleansing of the mucous membrane of the affected surfaces, and in applying astringent and antiseptic medications.

For the relief of pain and tenesmus, suppositories containing a grain of the watery extract of opium, a quarter of a grain of cocaine, and a quarter of a grain of belladonna will be sufficient.

The rectum should be cleaned at least twice a day by means of a hot douche of corrosive sublimate 1 to 20,000, or protargol 1 to 1000, or, if these solutions occasion severe pain, by a saturated solution of boric acid.

When the acute symptoms have subsided, strong solutions of silver nitrate are employed, 1 to 1000 and 1 to 500, in smaller quantities. When the general catarrh is cured, leaving only ulcers or hyperæmic patches, these are touched directly with a strong solution of silver nitrate (ten per cent.), or with one of the other agents alrea mentioned in the treatment of chronic gonorrhœa.

In some cases, when a discharge persists, two per cent. soluti of alum or of tannin injected into the rectum will prove servic able.

Gonorrhœa of the mouth, though of exceeding rarity, has been o served as an acute stomatitis, in the discharges of which were fou gonococci.

GONORRHŒA OF THE EYE.

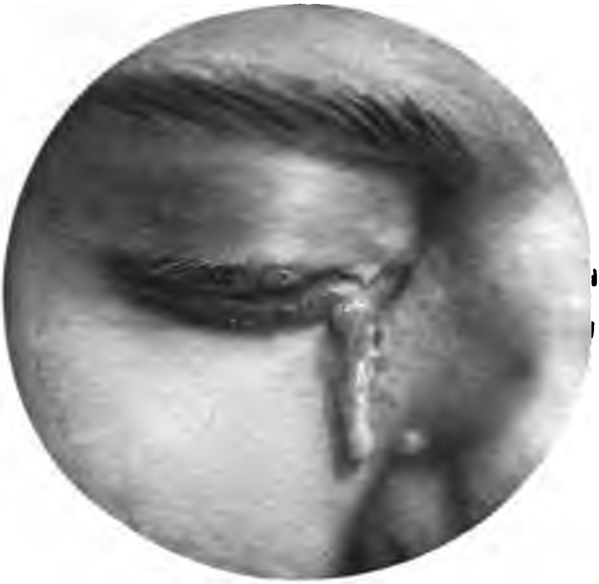
GONORRHŒAL CONJUNCTIVITIS—*Purulent Ophthalmia; Gonorrha Ophthalmia; Acute Blennorrhœa in Adults.*—This is a violent infla mation of the conjunctiva, characterized, in its usual form, by gre swelling of the lids, serous infiltration of the bulbar conjunctiva, a the free secretion of contagious pus.

Cause.—The source of contagion can usually be traced to an acu gonorrhœa or gleet, or to an eye similarly affected, soiled fingers linen being the usual means of transmission.

The gonococci of Neisser are present in great abundance duri the purulent stage, being found within the cells. Later they penetra the epithelium and enter the lymph-spaces of the subconjuncti tissue. The secretion from vaginal leucorrhœa, which is not u common in young girls, may produce a conjunctivitis of very ana gous type.

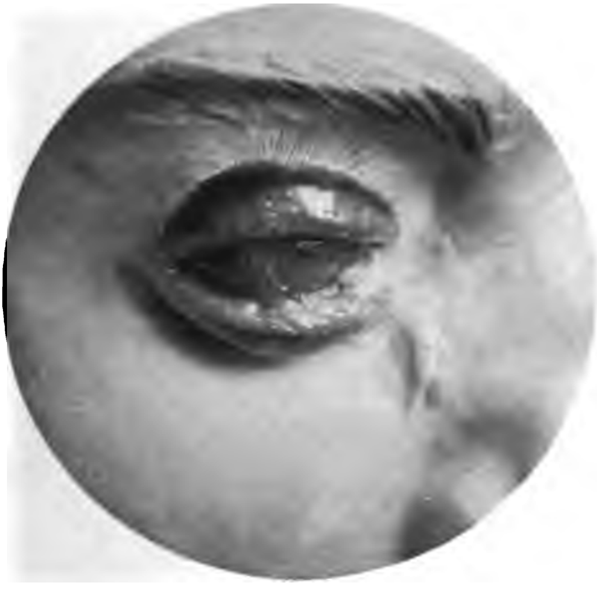
Symptoms.—The symptoms appear from twelve to forty-eight hou after inoculation, and at first resemble those of an ordinary catarr conjunctivitis. They speedily give place to great swelling of the l (Fig. 66), intense congestion and chemosis of the bulbar conjuncti which forms a ring of infiltration around the cornea, and thicken of the palpebral conjunctiva, which becomes rough and dark red color, and is dotted over with spots of ecchymosis. (Fig. 67.) T slightly turbid discharge of the early stage changes to a yellow greenish-yellow pus, which is secreted in great quantities. T vitality of the cornea is soon threatened, and, unless the disease properly managed, ulcers form, either small, oval lesions near t margin of the cornea, or larger ones at its centre. These may t minate in healing, or perforation may take place. In the event of t latter mishap, incarceration of the iris in the wound and the formati of an adherent scar or leucoma result. This scar may bulge forwa and form a partial anterior staphyloma, or, if the prolapse has be an extensive one, the whole cornea is involved, and the protrudi cicatrix is known as a total staphyloma. In bad cases the infla mation travels through all the tissues of the eyeball, which passes i

FIG. 66.



Gonorrhœal conjunctivitis. Swelling of the lids and free discharge.

FIG. 67.



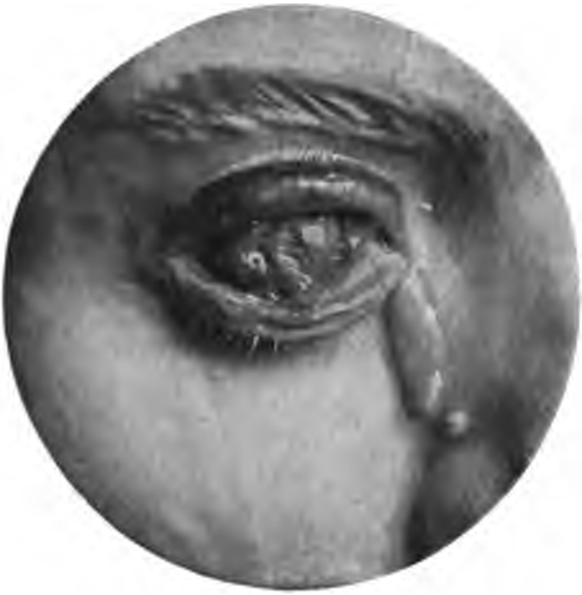
Gonorrhœal conjunctivitis. Infiltration of bulbar and palpebral conjunctiva

a state of general inflammation or panophthalmitis (Fig. 68), ending in atrophy and shrinking of the bulb.

Gonorrhœal ophthalmia neonatorum, due to gonococcic infection from the genital tract of the mother, has an incubation of one or two days and is often bilateral. The inflammatory symptoms are those characteristic of the infection in the adult, but even more intense and rapidly destructive.

Gonorrhœal conjunctivitis reaches its height in about ten days, and then gradually subsides in from one to two months. Sometimes it passes into a chronic type of inflammation, with great redness of the palpebral conjunctiva and hypertrophy of the papillæ. The right eye is usually first affected; the left one may escape or may be inoculated; sometimes, however, both organs are simultaneously inflamed.

FIG. 68.



Gonorrhœal conjunctivitis passing into a panophthalmitis.

Diagnosis.—This acute infection must be distinguished from gonorrhœal rheumatic ophthalmia in the adult (see table, p. 198), and from chemical or traumatic conjunctivitis in the new-born incident to bichloride vaginal injection of the mother, or prophylactic silver instillations to the eyes of the infant; the chemical conjunctivitis is rapid in onset, brief in course, and gonococci are not found in the discharge.

Prognosis.—This is always grave, and, unless the disease is trea
from its incipiency, corneal scars, or the more serious sequelæ of p
foration which have just been described, are likely to result.

Treatment.—Every case of true gonorrhœal conjunctivitis should
isolated. Patients suffering from gonorrhœa should be warned of
danger of infecting their eyes and the eyes of those around them.
usually one eye alone is affected, the other may be protected
sealing it with an antiseptic bandage the edges of which are ma
secure by fastening along them strips of gauze painted with flexi
collodion, or by the application of Buller's shield, which consists
a watch-glass of the ordinary form fitted in a square piece of r
ber adhesive plaster, which is carefully applied to the brow, tem
lower margin of the orbit, and nose, and secured with additio
strips to prevent the discharge from getting under the edges. T
watch-glass is directly in front of the eye and permits its constant
spection. Great care must be exercised in applying this bandage,
cause if any of the discharge should be confined beneath it, or in
way should find entrance under the edges of the plaster, the cha
of infection would be greater than without the bandage. Gon
rhœal conjunctivitis of the new-born is guarded against by inst
ing in each eye immediately after birth a few drops of a five
cent. solution of protargol or a two per cent. solution of sil
nitrate. The curative treatment both for infants and adults is
follows: During the earlier stages *cold* is the most useful ag
This may be applied by means of Leiter's tubes, but it is more c
venient to place upon a block of ice square compresses of patent l
which in turn are laid upon the swollen lids and as frequently chan
as may be needful to keep up a uniform cold impression. The sa
result is obtained by using small bladders containing crushed ice ;
they are not so comfortable as the squares of chilled lint.

The discharge should be constantly removed. This may be d
by irrigating the conjunctival cul-de-sac at intervals of not more t
half an hour with a saturated solution of boric acid or a solution
bichloride of mercury 1 to 8000. It is a mistake to use strong so
tions of sublimate in the treatment of this disease, because t
increase the liability of the cornea to ulceration, and, moreover, i
not possible to employ them in such strength that the germici
properties of this drug will be efficient.

As soon as the secretion is free and creamy, which is early
the disease, silver nitrate is the best of all remedies. The lids sho
be thoroughly everted without pressure upon the globe, the inflam
conjunctiva freed from all secretion, and a solution of this drug ten

twenty grains to the ounce applied with a cotton mop or camel's-hair brush to the exposed surfaces. The excess should immediately be neutralized with a solution of common salt a teaspoonful to a cup of water, flooding the surface until every particle of the white film produced by the silver has been washed away. The lids are then returned to their place. This application may be repeated once in twenty-four hours.

If a corneal ulcer forms and is centrally situated, atropine drops four grains to the ounce should be instilled every three or four hours; a marginal ulcer, with a tendency to perforate, may be treated in like manner with a solution of eserine one-sixth to one-half grain to the ounce, or, as this drug, while it has distinct value in preventing sloughing of the cornea, tends to increase the hyperæmia of the iris and the tendency to the production of iritis, it may be used every four hours during the day and a drop or two of the atropine solution at night.

If the chemosis of the conjunctiva is very great, scarification may be tried, and will occasionally be beneficial. Great swelling of the lids, tending by their pressure to endanger further the nutrition of the cornea, may be relieved by canthotomy,—that is, by cutting through the external commissure of the affected eye.

During the stage of corneal ulceration, should it occur, the cold applications previously described may be substituted by hot fomentations applied by means of squares of antiseptic gauze wrung out of carbolized water of a temperature of 120° F. and frequently changed. These applications are useless unless they are really hot.

Many other drugs in addition to those named have been used for irrigating the conjunctival cul-de-sac. Of these, the most important are mercuric cyanide 1 to 1500, protargol 1 to 2000, hydrogen peroxide, aluminium sulphate eight grains to the ounce, carbolic acid one-half to five per cent., and potassium permanganate. Of the last-named drug a tepid solution 1 to 5000 should be prepared, and the conjunctival cul-de-sac freely flushed twice a day, at least one litre being employed at each irrigation. The irrigations are best given with the aid of a special *laveur*, although an ordinary irrigating apparatus is useful.

During the entire course of the treatment the lids should be kept greased with pure vaseline, which should also be freely introduced within the conjunctival cul-de-sac.

Depletion is sometimes practised, but, unless the indications for canthotomy are present, its value is questionable. The same may be said of the practice, once common, of beginning the treatment by bringing the patients under the influence of mercury. Usually the are debilitated, and supporting treatment—quinine, iron, strychnine and milk punch—is essential. If the pain is severe, there is no objection to the use of morphine or opium, the latter drug having a goo influence on the sloughing process in the cornea.

Rheumatic Gonorrhœal Ophthalmia.—This disease is occasionally seen during gonorrhœa, and does not depend upon the introduction into the eye of infecting material from the urethra. It is apt t occur in patients who suffer from articular complications. It is bilateral, mild in character, and resembles a moderate catarrhal conjunctivitis. Sometimes iritis complicates it.

The treatment of ordinary catarrhal conjunctivitis is indicated unles there be iritis, and then the measures elsewhere described are suitable

Virulent Gonorrhœal Conjunctivitis.	*Rheumatic Gonorrhœal Ophthalmia.*
A rare but serious affection.	More common but less serious.
Essential cause is inoculation with gonorrhœal pus from without; violently contagious; gonococci abundant in pus.	Probably the causative agent comes fro within through the blood. Probabl metastatic; gonococci not found except in the later stages and then wit difficulty.
Not dependent on or necessarily coincident with rheumatoid affections.	Is coincident with gonorrhœal arthriti
May affect subjects not afflicted with urethritis, as in infants (ophthalmia neonatorum).	Occurs only in patients with gonorrhœ urethritis.
Usually affects only one eye, but may be transferred to the other.	Commonly the disease is bilateral in th beginning; or rarely may move fro one eye to the other.
The conjunctiva is always the structure primarily involved.	Disease usually starts in the iris membrane of Descemet and may later involve the oculo-palpebral conjunctiv
No tendency to recur in subsequent urethritis.	Marked tendency to recur.
Prognosis extremely grave; often loss of the eyesight.	Prognosis favorable; no loss of eyesight.
Treatment must be specific and active.	Treatment need be only symptomatic.

The epidemic conjunctivitis due to the Koch-Weeks bacillus or t the pneumococcus affects both eyes with but moderate severity, is usually observed in more than one member of a family and fails to sho gonococci in the moderate discharge.

GONORRHŒAL RHEUMATISM.

Gonorrhœal rheumatism, a local expression of gonococcic septicæmia, commonly affects the joints. It may, however, involve th tendons, nerves, bursæ, pericardium, endocardium, and meninges of the cord. It is due to systemic poisoning by the specific micro-organisms or by the ordinary bacteria of suppuration and the toxalbumens formed by these germs. When it is caused by gonococci carried from the urethra or from a wound into the circulation and lodged at remote points, the inflammation is fibrous and adhesive in type.

Finger in a fatal case of gonorrhœal rheumatism discovered gonococci in the vegetations of the endocarditis. There was also myocarditis, due to the presence of these germs.

When there is free pus-formation the ordinary pyogenic microbes are found.

The disease may begin before the third week of the urethritis, though it commonly develops much later.

In the order of frequency the knee, ankle, wrist, and elbow are the joints commonly involved. Usually more than one joint is inflamed at a time, though in about one-third of all cases the disease is monarticular.

It develops in about two per cent. of all cases of urethritis, and is far more frequently observed in men than in women. It may complicate gonorrhœa of any mucous surface,—the conjunctiva, for instance.

ARTHRITIS is the commonest manifestation of gonorrhœal rheumatism. It may be ushered in by general rheumatic pains, but more commonly is characterized by rather sudden swelling, pain, tenderness, and redness of the affected articulation. There is synovial exudation, with fixation of the joint in the position which most relaxes its synovial investment. There is moderate fever. Pain is severe.

These acute symptoms usually last for several days. The fever then subsides, and complete resolution may quickly follow, or the patient may suffer for weeks or months from swelling, tenderness, and harassing pain, subject to occasional exacerbations in accordance with the condition of the urethra. Such joints commonly remain partly or completely stiff. Rarely suppuration takes place, characterized by constitutional and local symptoms of pus-formation, resulting, if the patient recovers, in ankylosis of the joint.[1]

Sometimes the chronic inflammation produces a condition of hydrarthrosis, attended with limitation of motion, but otherwise causing little pain and but slight disability. The effusion usually undergoes absorption. Occasionally it lasts for weeks or months, causes stretching of the ligaments, and finally preternatural mobility and profound alteration in the joint.

Symptoms.—There is absolutely no characteristic feature of t joint affection which will enable the surgeon, from a local examir tion, to distinguish gonorrhœal inflammation from the lesions ordinary rheumatism. In making a diagnosis, however, the followi points should be borne in mind. In gonorrhœal rheumatism there a preceding history of urethritis, and the severity of the rheuma attack varies in proportion to the exacerbations and remissions the urethral inflammation. The disease rarely pursues the acı course observed in ordinary rheumatism, but rather has a tenden to become chronic, and after it has once occurred is prone to relap in case of new infection of the urethra.

When several joints are affected the distinction between gon rhœal arthritis and that due to rheumatism is exceedingly difficult make. In the former case, however, but few joints are involv rarely more than two or three, and in these the inflammation d not appear synchronously, but one inflames after the other. T fever is never very high, except in the rare cases when suppu tion occurs, nor is sweating so pronounced a symptom as in rhe matism.

Occasionally the gonorrhœal rheumatism takes the form of pe arthritis. The symptoms are much the same as those of arthri except that there is no exudation into the joint-cavity, and the r ness, œdema, pain, and tenderness are somewhat more marked. commonly terminates in resolution, but may cause ankylosis.

The following tabulation of the symptomatology of rheumatic fev chronic rheumatism, gout, and gonorrhœal arthritis may prove s viceable.

Rheumatic Fever.	*Chronic Rheumatism.*	*Gout.*	*Gonorrhœal Arthri*
Most frequent in young adults.	Most frequent in older persons.	Most frequent in older persons.	Most frequent in yo adults.
Gonococci are not found in discharge.			Gonococci are foun urethral discharg
Urethral discharge comparatively rare.			Urethral discharge ways present, tho it may be found in the urine.
Family history may be positive.	Family history often positive.	Family history usually positive.	Family history n tive.
Etiologic relationship to cold and damp.	Symptoms distinctly influenced by weather.	Symptoms related to diet.	Primary relationshi urethra.
Onset sudden.	Onset insidious.	Onset sudden with perhaps prodromes.	Onset sudden, no dromes.
Constitutional phenomena severe, high fever, and often chill.	Constitutional phenomena mild or absent.	Constitutional phenomena mild.	Constitutional phen ena mild and t sient.
Always polyarticular and wandering from joint to joint.	Usually polyarticular.	Usually monarticular.	Nearly always mo ticular.

Rheumatic Fever.	*Chronic Rheumatism.*	*Gout.*	*Gonorrhœal Arthritis.*
Predilection for large joints, a number at the same time.	Large joints.	Great toe.	Knee most frequently involved, may attack other joints, but generally only one at a time.
Distinctly acute inflammatory affection with great tenderness, redness, heat, and fluctuation.	Mildly inflammatory, rarely marked hydrarthrosis.	Never hydrarthrosis.	Usually hydrarthrosis slowly.
No tophaceous deposits.	No true tophaceous deposits.	Always tophaceous deposits in joints or ears.	Never tophaceous deposits.
Acid sweats marked.	Less marked but often present.	Not so conspicuous.	Never present.
Cardiac complications frequent.	Less frequent.	Myocarditis and arterio-sclerosis.	Cardiac complications rare.
Urine loaded with urates and uric acid crystals.	Urine is less characteristic.	Urine loaded with uric acid and urates.	Urine contains clap shreds, but is not excessively acid.
The eye and usually the bursæ and tendons escape in these three.			Frequent eye complications, bursitis, and tenosynovitis.
Relapses are frequent, and may or may not be associated with recurrence of urethral discharge.			Relapses are more or less dependent on the condition of the urethra.
Disease is cured by salicylates and anti-rheumatic treatment.	These remedies are useful combined with tonics.	Dietetic, hygienic, and medicinal treatment are effectual.	Internal remedies are useless; the urethritis must be cured by local remedies.

TENOSYNOVITIS—This affection develops usually after the acute stage of gonorrhœa has passed. It is often preceded by wandering muscular and articular pains, chill, and moderate fever. The involved tendon exhibits over its course redness and œdematous swelling; there is synovial effusion, producing either crepitation or distinct fluctuation. Tenderness is sometimes extreme, and the patient may suffer from continued pain, greatly increased by attempts at motion. The more acute symptoms rapidly subside, but pain and fixation may last for several weeks. The tendons most commonly involved are the extensors of the fingers, the flexor of the thumb, and the tendons of the toes.

Complications of gonorrhœal rheumatism are rare; as localized manifestations of the ptomaine- or germ-poisoning, pericarditis, endocarditis, pleuritis, and meningitis develop only exceptionally, while myalgia and neuralgia are occasionally so pronounced as to call urgently for treatment.

PHLEBITIS.—Heller has collected twenty-six cases of gonorrhœal phlebitis, which, though occurring independently of joint involvement, is usually accompanied by this complication. It is commonest in men and occurs in the fourth or fifth week of a first attack. The internal saphenous vein is most frequently involved; next the common femoral,

the superficial veins of the abdominal parietes, the veins of the corpo
cavernosa, sometimes those of the arm. There are acute pain and feve
Until the external veins are involved, forming indurated cords, the dia
nosis cannot be made. Two out of the twenty-six cases died,—one
embolus and one of sepsis. One required amputation at the thig
The treatment is by rest, evaporation, lotions, and later by absorbent

Diagnosis.—The gonococcic nature of such affections as pericarditi
pleuritis, and meningitis can be determined only by the discovery
these organisms in the blood, even though a gonococcal urethri
be present. This requires the removal by veno-puncture of abo
twenty cubic centimetres of blood and its immediate culture, since t
diplococcus intracellularis meningitidis, the micrococcus catarrhal
and some others decolorize by the Gram method.

The *treatment* of gonorrhœal rheumatism depends for its succe
upon the cure of the local infection. The best prophylactic treatme
is the employment of urinary antiseptics. Salicylic acid and the sa
cylates should always be tried, since occasionally the attack is or
nary rheumatism, and if the latter be mild in type and involve b
few joints a differential diagnosis in the presence of chronic gono
rhœa will be scarcely possible. Potassium iodide is sometimes se
viceable. Full doses of salol are nearly always beneficial, and in t
chronic and obstinate cases quinine pushed to its physiological lim
together with bichloride of mercury one-sixtieth of a grain thrice dai
will sometimes act favorably.

For the acute stage absolute rest, with the joint in the most co
fortable position, the application of cold, preferably in the form of
ice-bag, and pressure as much as can be endured with comfort, t
gether with constitutional treatment for fever, are the best therapeu
procedures. When the acute stage has passed, the affected joi
should be wrapped in an ointment composed of mercurial ointme
belladonna ointment, compound iodine ointment, and cosmoli
equal parts of each. They should be bandaged firmly, and shou
be vigorously massaged once daily, small doses of iodide, or of q
nine and bichloride, being continued in the mean time.

When a large joint, such as the knee, is markedly distended by
intra-articular effusion, causing intense suffering, incision, evacuati
of the fluid contents and fibrinous bodies, irrigation with carbolic sol
tion 1 to 500, followed by closure with or without drainage, affo
immediate relief from pain and often accomplish a permanent cu
Even though there be little or no pain, persistent large effusions shou
be thus treated. In suppurative cases the operative indications a
imperative.

CHAPTER VI.

STRICTURE OF THE URETHRA.

A STRICTURE is a temporary or permanent narrowing of the urethral canal, caused by organic changes in the tissues which make up its walls, or by muscular spasm.

Strictures may be congenital or acquired.

Congenital stricture is extremely rare, except at the meatus or in its immediate vicinity. Even these narrowings are often the result of infantile balanoposthitis, and thus not really congenital. A narrowing of the meatus, reducing it almost to pin-point size, may exist from birth without giving rise to appreciable difficulty, and, unless some urinary symptoms appear, requires no treatment.

The normal narrowing at the meatus is of physiological importance in favoring the projection of a strong, smooth stream of urine and the vigorous ejaculation of the sperm: hence free division of the meatus should not be advised on insufficient grounds. Not infrequently the operation may leave the patient with an artificial balano-hypospadia and diminished projectile force.

Congenital strictures should, however, be operated upon promptly when urinary symptoms arise which reasonably can be traced to them, or when they interfere with the proper treatment of more deeply seated morbid conditions of the urethra or of the bladder.

Acquired stricture is classified in accordance with its pathology under these general headings:

1. INFLAMMATORY.
2. SPASMODIC.
3. ORGANIC; (*a*) of large calibre; (*b*) of small calibre.

1. **Inflammatory stricture** is due to an acute catarrhal inflammation with recent soft exudate, causing swelling of the mucous membrane and encroachment on the urethral calibre. It is of short duration, and never causes retention, except when complicated by muscular spasm. It is often the first step in the formation of organic stricture.

Treatment.—The treatment is that appropriate to acute anterior urethritis. The term inflammatory stricture is misleading, since some authors thus designate true organic strictures,—*i.e.*, those which ultimately result from chronic inflammation with formation of fibro tissue.

2. **Spasmodic stricture** is a temporary narrowing or obliterat of the urethra, due to contraction of the involuntary or volunta muscles investing it. This contraction is either reflex or psychical its origin, and the compressor urethræ is usually the muscle at faul

Reflex muscular spasm commonly depends on irritation tran mitted from some hyperæmic point of the urethra, as from the activ inflamed mucous membrane of the posterior urethra, or from a pat of granular urethritis situated in or near the bulb. More rarel may arise from irritation at a greater distance, as from fissure of t anus, hemorrhoids, worms, cancer of the rectum, etc.

Among the causes of spasm may be mentioned strongly acid irritating conditions of the urine, as in cantharidal poisoning or t uric acid diathesis, and urethral hyperæsthesia from sexual exce Organic stricture is the usual predisposing factor in the developm of the symptoms of spasmodic stricture.

The retention of urine incident to overdistention of the bladder, acute fevers, or surgical operations, especially those upon the anus a the rectum, is probably as often the result of vesical inhibition as urethral spasm, although it is usually attributed to the latter.

Numerous cases have been reported in which a more or less p sistent spasm has been attributed to a small meatus, since this relieved by meatotomy; but it must be remembered that spasmo stricture is particularly apt to occur in nervous, excitable, irrita young men, allied in type to hysterical women, and that in su patients any marked mental impression may cause a disappearance existing symptoms. A case has been reported in which all the sym toms of deep urethral obstruction existed for ten years, and were lieved immediately and permanently by a single catheterization result which would doubtless have been attributed to a meatoto if that had been required as a preliminary operation. If the mea is too small to admit a good-sized sound, in the presence of oth wise inexplicable urinary symptoms a cutting operation is clea indicated.

Spasmodic stricture due to psychical cause is instanced by the hibiting effect which shame or even a sense of hurry exerts over function of micturition.

Diagnosis.—The diagnosis of spasmodic stricture is founded up the sudden onset of either dysuria or retention of urine without infla matory symptoms and without preceding symptoms of urethral c struction. Sometimes the stream is irregularly interrupted, a conditi designated as stuttering micturition. The introduction of a full-sized metal instrument may be resisted at first, but on gentle continued pressure the contracted muscles may be felt to yield and the instrument readily slips into the bladder.

Treatment.—The treatment of spasmodic stricture varies in accordance with the cause. When symptoms recur, careful search always should be made for organic stricture; this, if cured, will be followed by disappearance of the tendency to spasm. Every pathological condition about the genitalia or rectum should be corrected, and in the absence of contra-indications full-sized sounds should be passed at regular intervals.

When spasmodic stricture is complicated by retention, the patient should be put in a hot general bath (106° to 110° F.), and directed to urinate while therein. A hot sitz-bath is equally efficacious, but should be continued not over fifteen minutes. If at the end of this time the bladder has not been emptied, the patient should be thoroughly dried, put to bed, and given suppositories containing opium and belladonna, or hypodermic injections of morphine. These palliative measures should, however, never be persisted in when the bladder is greatly distended,—*i.e.*, is readily perceptible on suprapubic percussion. The possible remote effects of overdistention of the bladder are far more to be dreaded than the slight discomfort attendant on the passage of an instrument: hence if the distention is great and the hot bath fails to give relief, catheterization should be practised at once. A soft rubber or an English gum catheter should be used first; if these fail, a metal instrument should be introduced. It must be borne in mind that under these circumstances the bladder is peculiarly liable to become infected; therefore the catheterization must be practised with the observance of all the antiseptic precautions customary in major operations. The surgeon's hands must be thoroughly cleansed, the instrument sterile, the glans and meatus disinfected, and the anterior urethra previously flushed out with an antiseptic solution.

3. **Organic Stricture.**—This, in the vast majority of cases, is due to a preceding urethritis or to traumatism, though a chancroid, chancre, or ulcer due to lodgement of a foreign body may subsequently be followed by cicatricial narrowing. Gonorrhœal urethritis is by far the most common cause.

Organic stricture may occur in persons of any age, but is most frequent between the ages of twenty and forty-five. Women are not entirely exempt. Gonorrhœal stricture is said to occur less frequently in negroes than in white men, the proportion being about one stricture to twenty-three cases of gonorrhœa in the negro, while in the white man it is about one in eight. The longer the duration of attack of gonorrhœa the more liable is the patient to have a strict The intensity of the attack is also of some importance in this reg The supposed development of stricture because of too rapid cur gonorrhœa is a popular myth. The more speedy the cure the likely are strictures to form, nor have strong irritating injections effect on the production of stricture unless they cause complicati such as abscess, or prolong the inflammation.

Inflammations of the urethra are peculiarly apt to become chr for several reasons. The canal affords periodical passage to urine, which is liable to become an actual irritant by reason changes in its composition ; erection, reflexly excited by inflamma intensely congests the urethral vessels, which, moreover, are espec abundant, and are prone to engorgement from the dependent pos of the penis and the absence of extra-vascular support incident to loose character of the spongy tissue. All these factors favor the sistence of congestion after a first attack of urethritis. The appr mation of the mucous surfaces of the urethral walls, normal du the intervals between micturition, is also unfavorable to the di pearance of the last traces of inflammation. Finally the gonoco exhibits a tendency to establish itself in the deeper layers of mucous lining, and particularly in the follicular and glandular d where it is inaccessible to direct treatment.

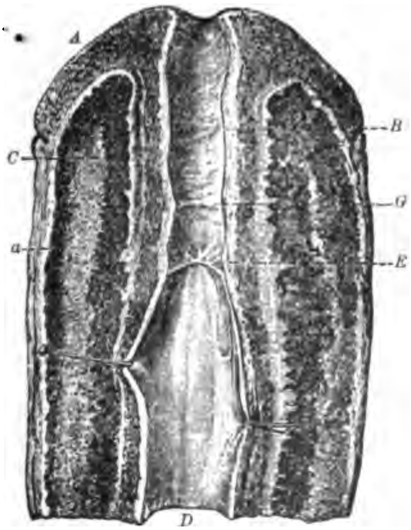
Harrison holds that in chronic granular urethritis the ure epithelium becomes so damaged at one or more spots as a consequ of prolonged inflammation that it permits the escape of minute q tities of urine into the tissues composing and surrounding the ure To prevent urine soaking farther into these tissues, inflammatory dation is excited, and barriers of lymph, which ultimately bec organized, are thrown out opposite the places where the leakages place. Thus splints of plastic tissue are formed corresponding to spot or spots where the epithelium has been most damaged by persisting inflammation.

Oberländer demonstrates the existence of two chief form chronic urethritis: (1) that in which the infiltration of the mu membrane is diffuse and superficial and the glandular elements not involved, and (2) that in which the glands of Littre are mark affected. Neelson has confirmed these views by a long series o topsies, which show that the glandular affection is extremely sistent, and easily recognizable even when cadaveric maceration destroyed the evidences of change in the mucosa and of the epith proliferation.

The rapidity of stricture development is dependent upon the nature of the original lesion. In case of rupture of the urethra narrowing of the lumen of this canal begins from the time the wound cicatrizes; that is, usually within a few weeks. In the case of gonorrhœa, however, the process is much more slow. The infiltration caused by this disease, unless complicated by periurethral abscess, is essentially chronic. It is always a matter of months, and usually of years, before this infiltration undergoes sufficient organization to encroach seriously upon the calibre of the urethra. It may be said in general terms that a stricture rarely develops within one year of the beginning of an attack of gonorrhœa. Guyon holds that the greatest number of strictures occur four to ten years from the beginning of the original urethritis.

Prolonged erection, excessive coitus, and masturbation have been regarded as competent causes of stricture, especially by the ardent believers in strictures of large calibre, who find this lesion in nearly every urethra, often without a history of gonorrhœa or of any of the sources of irritation previously mentioned. Theoretically stricture is possible from such causes, but practically it is of the greatest rarity.

FIG. 69.

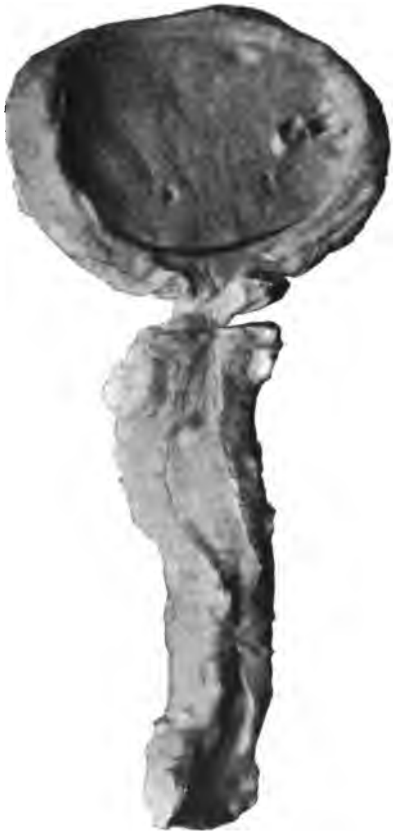


Linear strictures. *A*, glans; *B*, glandular urethra: *C*, spongy body; *D*, urethra dilated behind the stricture; *E*, linear stricture; *G*, linear stricture less developed; *a*, cavernous body. (Voillemier.)

Traumatic stricture follows such wounds and contusions of the perineum as have caused partial or complete laceration of the urethra. Kicks in the perineum, falls astride of a resistant body, and fractures of the pelvis often cause such ruptures. "Fracture of the penis,"—that is, a sudden twist or bend of the erect penis, which causes subcutaneous rupture of the erectile tissue; "breaking a chordee,"—*i.e.*, violently straightening the curve incident to the inflammatory infiltration of the urethra and periurethral tissues; injuries due to the rough and clumsy use of urethral instruments; surgical treatment of previously existing strictures, such as incision, excision, cauterization, and electrolysis,—all these causes may produce traumatic strictures.

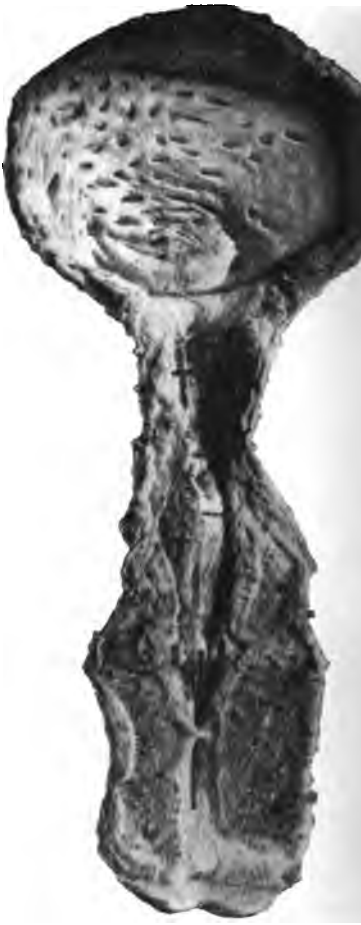
Clinical Forms of Stricture.—The strictured part of the urethra varies greatly in extent, from a mere cord-like band, *linear stric* (Fig. 69), to one slightly broader, *annular stricture* (Fig. 70), and fr that to a contraction which may involve two or three inches of

Fig. 70.



Annular stricture.

Fig. 71.



Tortuous stricture.

canal, changing it into a devious, irregular channel, *tortuous strict* (Fig. 71.)

Strictures may also be classified as: 1. *Soft or recent*, the s epithelial exudate not yet having become extensively organized i connective tissue. Under this heading would be included strictu of large calibre and those cases of chronic urethritis which resem stricture or constitute its first stage. 2. *Cicatricial*, characterized an ill-defined mass of fibrous tissue often cartilaginous in consistency. The traumatic strictures are made up entirely of fibrous tissue; the gonorrhœal strictures still exhibit traces of the original structure of the parts.

There is also a peculiar form of contraction of the meatus, which appears as a diffuse induration of the mucous membrane, scar-like in appearance and cartilaginous in consistency; this extends outward on the glans and for some distance inward; it is apparently a form of scleroderma. Local treatment is of little use, but there is often some spontaneous improvement after a considerable lapse of time.

Strictures are further classified as,—

1. *Simple*,—that is, exhibiting only the symptoms and reactions characteristic of the majority of strictures.

2. *Irritable*.—Instrumentation causes unusually severe pain, is sometimes followed by hemorrhage, and excites undue local inflammation or occasions urethral fever.

3. *Resilient*, *Contractile*, *or Recurring*.—The stricture if untreated steadily becomes tighter. Even if it can be dilated, it again contracts so rapidly that this method of treatment is without benefit.

In accordance with the extent to which they narrow the urethra, strictures are either of *large calibre* or of *small calibre*.

The terms *permeable* and *impermeable* indicate whether or not an instrument can be passed through the narrowing.

Every stricture following a urethritis must at some time have been a stricture of large calibre, but just when such a stricture becomes a pathological factor and is able to give rise to symptoms is an unsettled point. There is no fixed calibre of the urethra, and the size of the meatus is not a reliable index as to the diameter of the canal behind it. The circumference of the flaccid penis affords the best indication as to the size of the urethra, the calibre of this canal increasing in proportion to the growth of the penis; but the ratio is only approximate and is liable to variation.

It must always be remembered that the urethra has certain points of normal constriction, notably at from one to three inches from the meatus and in the vicinity of the pubic angle, and that it is impossible to distinguish by means of instruments alone these natural irregularities from constrictions of equal calibre due to incipient stricture. However, when narrowings in any point of the urethra are associated with gleet, frequent urination, dribbling after micturition, and lumbar and hypogastric pain, it is safe to infer that there is some degree of urethral stricture.

The increased friction and resistance resulting from even a slight fibrous periurethral deposit may disturb the equilibrium which l been established and maintained between the usual efforts and pov of the bladder as an expulsive organ and a certain average of res ance which must be overcome before it can empty itself. As a res the bladder becomes irritable, and is often rendered still more so inflammation of the posterior urethra incident to backward extens of the catarrhal process usually active at the seat of narrowing. Tl is caused one of the most constant of the stricture symptoms,— frequent urination.

The imperfect closure of the tube occasioned by the inflammat infiltrate, which prevents the urethral walls from being pressed tigl to each other by their investing layer of involuntary muscle, cau imperfect expulsion of the last drops of urine, and produces anotl characteristic symptom,—dribbling at the end of micturition.

The retention and decomposition of these last few drops, togetl with the abnormal friction between the stream of urine and urethral walls at the site of narrowing, cause a subacute inflamn tion of the mucous membrane, accompanied by a catarrhal or mu purulent discharge, constituting the condition of *gleet*.

Pain is developed in the lumbar and hypogastric region by ref irritation transmitted from the area of inflammation and from irritated bladder.

Where the urethral calibre is markedly diminished, the relat between causes and effects is, in the main, as just stated. As to h far the narrowing must go before such symptoms are excited, no d matic assertion can be made. Otis has promulgated a scale of re tion between the calibre of the urethra and the circumference of flaccid penis, any departure from which he regards as an evider of the existence of stricture. This scale doubtless represents ac rately the distensibility of the male urethra, but it does not repres what can fairly be called its normal calibre, and fails altogether recognize the fact that there are points of physiological narrow along the pendulous urethra.

The variation in size and dilatability of the different parts of urethra have long since been clearly demonstrated by Delpet, Guy Sappey, and many others.

Otis, however, in effect assumes that the urethra should be a tu of uniform calibre, at least anterior to the triangular ligament, and instrument which he has devised,—the urethrometer,—when us under the guidance of his tables, will detect apparent strictures in majority of normal urethræ. His teachings have, nevertheless, be of great value, since they have demonstrated the distensibility of normal urethra, have clearly shown the full pathological value of true stricture, however slight, and have rendered urethral surgery more exact.

For purposes of classification it may be admitted that, exclusive of cases that are best described as examples of chronic urethritis, there are others in which the superficial inflammation has largely disappeared, and in which the periurethral or submucous deposit has begun to contract and to diminish the lumen of the canal, the contraction still allowing fairly good-sized instruments to pass with ease. Such narrowings may be classed as strictures of large calibre. Strictures of small calibre are those in which the encroachment upon the canal is more pronounced.

A purely arbitrary standard has been established for convenience in classifying organic strictures in accordance with the degree of narrowing. This is expressed in the following definitions:

Strictures of large calibre are those through which a sound or bougie larger than No. 15 (F.) can be passed.

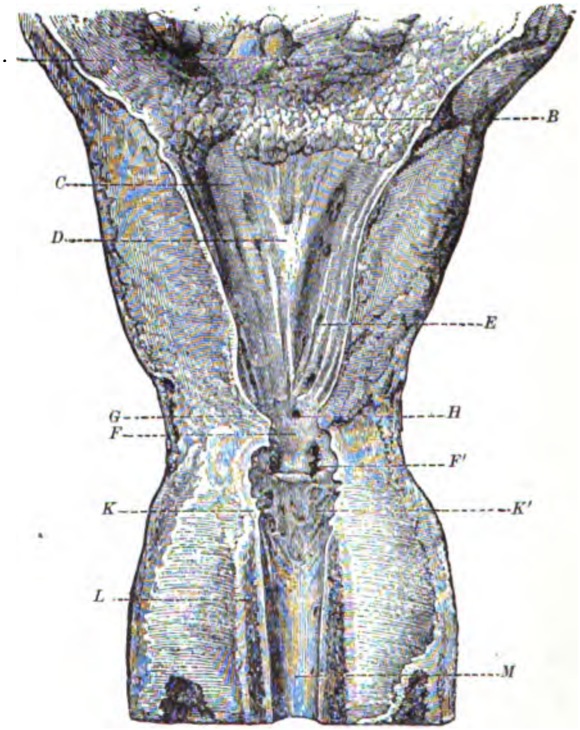
Strictures of small calibre are those through which instruments larger than No. 15 (F.) cannot be passed.

LOCATION OF STRICTURE.—In the large majority of cases gonorrhœal stricture is situated in the bulbo-membranous portion of the urethra. The next most frequent seat is the first two and a half inches of the urethra, and the least frequent seat is the middle of the spongy urethra. Stricture of the prostatic region is extremely rare. The occurrence of stricture in these regions is due to the facts that they are exceptionally vascular, and, with the exception of the membranous urethra, are rich in glands and follicles, and that chronic urethritis is apt to become localized at these points. Gravitation in both regions favors chronic congestion.

The differences of opinion in regard to the localization of stricture are due to the different stand-points from which the subject is regarded. Those who demand evidence of some organic change before admitting the existence of stricture, and who base their views on the examinations of specimens in museums, differ greatly in their conclusions from those who depend upon the findings of the urethrometer, and who believe in an almost unvarying relation between the calibre of the urethra and the size of the penis. In three hundred and twenty-one specimens examined by Sir Henry Thompson the stricture in two hundred and sixteen, or sixty-seven per cent., was found in the bulbo-membranous region; in fifty-four, or seventeen per cent., within two and a half inches of the meatus; and in fifty-one, or only sixteen per cent., in the intermediate spongy portion. Otis describes two hundred and fifty-eight strictures under his care as situated, on hundred and fifteen, or forty-four and one-half per cent., in the firs inch and a quarter of the urethra; one hundred and twenty-nine, o fifty per cent., from one and a quarter to five and a quarter inche from the meatus; and only fourteen, or five and one-half per cent from five and a half to seven and a quarter inches,—*i.e.*, in the regio of the bulbo-membranous urethra. It can scarcely be doubted tha many of these "strictures" were points of physiological narrowing.

If narrowings at the meatus are excepted, gonorrhœal stricture

Fig. 72.



Traumatic stricture. ***A***, **bas-fond of bladder;** ***B***, **ecchymosis of the mucous membrane of t vesical neck:** ***C***, **prostatic urethra:** ***D***, **verumontanum, much deformed;** ***E***, **lacunæ;** ***F***, **position greatest narrowing: mucous membrane transformed to a thin layer of flat epithelial cells:** ***F'***, **sm diverticula in the fibrous tissue;** ***G***, **cicatricial tissue;** ***H***, **small round cavity;** ***K***, **spongy tissue co pletely destroyed;** ***K'***, **mucous membrane in front of the stricture, thin and rugous;** ***L***, **spongy bod** ***M***, **anterior urethra. (Voillemier.)**

are usually single, though two, three, four, or even more may present.

Traumatic strictures are nearly always single, and their situatio varies with the cause. They occur in the mid-spongy portion of t urethra after rupture of a chordee; at the root of the penis when caused by "false movements" in coition; in the perineo-bulbar portions of the urethra when following contusions of the perineum; and in the membranous portion after pelvic fractures.

They are most frequently found involving the bulbous urethra. (Fig. 72.)

Strictures following ulceration due to chancre, chancroid, or the lodgement of foreign bodies are usually found at or near the meatus.

Changes in the Urethra.—The urethra behind a stricture undergoes certain progressive changes. It at first becomes deeply congested, thinned, and dilated. As the stricture grows smaller, alterations in the mucous membrane become more and more marked. The increasing pressure causes a corresponding increase in the pouching or dilatation; decomposition of the retained urine sets up superficial inflammation, and erosion of the mucous surface occurs, with denuding of the epithelial layer; ulceration follows, which, as it progresses, allows the escape of urine into the spongy tissue. Sooner or later this causes suppuration. The pus, whether in minute quantity or as the contents of a recognizable abscess, finds its way towards the skin, and after its discharge leaves urinary fistulæ. These fistulæ, when first formed, have soft, yielding walls, but these gradually become dense and indurated, undergoing the same pathological changes as did the original strictured region. Even after the formation of a large fistula progressive contraction still takes place at the posterior surface of the urethral stricture, since the fistulous opening cannot prevent the constant contact of urine with this portion of the narrowing. As a result, the urethral outlet is more and more tightly sealed, and all the urine is forced to pass by the new way.

Gradually the walls of the fistula become indurated, its lumen is narrowed by contraction, and the free passage of the urine is again obstructed. Under such circumstances it is extremely rare to observe any yielding in the stricture so that water can be voided per urethram. Ordinarily other abscesses develop in the way already described, and other fistulæ are formed.

Wassermann and Halle have shown that the essential anatomico-pathological characteristic of the lesions of gonorrhœal stricture is their multiplicity, as opposed to the precise limitation and localization of traumatic strictures. In all cases of old gonorrhœal strictures the urethra exhibits pronounced lesions throughout a great part of its extent. These are most marked in the region of the bulb. The calibre of the urethra is lessened anterior to the stricture ; behind there is dilatation.

Because it is surrounded by compressible, elastic spongy tiss the soft walls of the normal urethra lie directly in contact with ea other, a cross-section showing it as a slit, transverse in the spon portion, vertical in the bulbar. When the periurethral tissues a thickened and rigid, the strictured urethra becomes an open ca with a lumen which varies in shape according to the position of t periurethral infiltration. In the posterior portion of the bulb t strictured urethra exhibits a tendency to take the form of a wi irregular, transverse opening, with its lateral angles extending alm as far as the fibrous envelope of the bulb.

The epithelial lining of the urethra is constantly altered. Thic ening and partial desquamation represent the commonest lesio These are found in all portions of the canal, even those least alter There is constantly observed a tendency towards the transformation the cylindrical epithelium to the stratified pavement form. Commo there is a single basilar layer of cylindroid cells with the long a perpendicular to the derm. The middle layer is made up of seve rows of polygonal, usually hexagonal, cells ; finally, there is a sup ficial layer continuous with the middle layer and made up of seve rows of flat cells with the long diameter parallel to the derm. Som times the flattened superficial cell-layer rests directly on the basi layer. All forms of transition are observed in the epithelial ce The epithelium may be thinned and atrophic, or there may be p liferation, forming vegetating masses which fill the urethral calib Finger states that there is a distinct relation between the type epithelial alteration and the pathological changes in the subjacent t sues. The distinctly dermoid and corneous epithelium (not observ in the membranous or prostatic urethra) is usually found in the gions where periurethral sclerosis is most pronounced.

It is important to recognize the fact that these various lesions the mucous membrane are not limited, but are almost universal.

The essential lesion of stricture is in the spongy body. As an ul mate result of inflammatory infiltration, fibrous tissue is gradua substituted for the elastic, extensible vascular tissue of the spon urethra, forming a compact inextensible avascular mass showing tendency towards retraction, atrophy, and obliteration. Usually t narrowing is caused by a fibrous ring, which may be regularly d posed or unequally deposited about the urethra. There is no syste in its distribution. Sometimes it is the upper segment, sometimes t lower or lateral segments, that are most profoundly involved. At t strictured point one-half or two-thirds of the diameter of the spongy body is altered and obliterated. This alteration often involves a considerable extent of the canal beyond the point retracted.

These lesions of the spongy body, limited and irregular in cases of chronic urethritis, are in fibrous stricture constant, deep, and extensive.

The arteries of the spongy body in old cases constantly exhibit an endarteritis and a periarteritis, sometimes proceeding to complete obliteration of the vessels. Behind the stricture the superficial inflammatory lesions are almost constant, and it is here that embryonal vegetations form by predilection. The sclerosed tissue surrounding the urethra is not homogeneous, but contains all the elements of normal spongy tissue. It is the result of a species of interstitial sclerosis, which, though completely modifying the appearance and the properties of the normal tissue, does not cause its total disappearance.

In case of traumatic stricture the contrary is the case. The spongy body is entirely replaced *in loco* by an ordinary fibrous cicatrix.

The glandular and lacunar lesions of stricture are constant. Adenitis with proliferation and epithelial transformation, glandular dilatation, and simple periadenitis are nearly always found, especially in the least altered portions of the strictured urethra. At the seat of stricture the glands have often disappeared or are scarcely recognizable. These glandular and lacunar inflammations play an important *rôle* in the production of the periurethral lesions, causing fibrous nodules to develop in the spongy body. The irregularities, the folds, and the nodular masses observed in the walls of strictured urethræ often originate in the glands and their ducts. Finally, the dilated and suppurating glands may cause periurethral abscesses, false routes, or fistulous tracts. When these fistulæ originate in the bulbar urethra it is from the region of one of the lateral angles of the canal that the fistulous tract passes. The sclerosed bulb is not traversed directly by this tract from above downward. It winds laterally round the half circumference of the bulb and opens through the skin. Sometimes the bulb is entirely dissected by two fistulous tracts placed symmetrically and laterally, uniting near a single suburethral pouch. These tracts are lined with stratified pavement epithelium continuous with the two surfaces: hence in closing them it is necessary to extirpate the whole tract. In exploring these tracts it must be borne in mind that they take a circuitous course, often entering the urethra by its lateral wall.

The opening of the urethra at the seat of stricture is commonly near the roof of the canal, since the bulk of the fibrous tissue is usually placed in the urethral floor, thus encroaching upon the lum of the canal from below upward. This opening may, however, b eccentric in any other direction.

The consistence of strictures varies with their age and with th amount of fibrous and elastic tissue they contain. Their *dilatabili* varies inversely with their consistence, as does their elasticity.

Section of a stricture of the annular or tortuous variety shows more or less imperfect ring of new inflammatory tissue, whose limi taper down gradually. This tissue is hard, yellowish white near th lumen and darker peripherally, where reddish islets are seen, th result of hemorrhagic infarcts, which form foci for new inflammato changes. Oberländer has shown that the inflammatory process pra tically begins in the glandular recesses. These are most abunda on the roof of the urethra, but the floor presents the greatest chang from the fact that the gonorrhœal process is always more acti there.

Complete obliteration of the urethra is extremely rare, and it doubtful if it ever happens except in the traumatic forms of strictu following extensive laceration or complete cross-crushing of th canal. The obliteration in this case is usually at least half an in wide, with fistulæ placed behind it.

SYMPTOMS OF STRICTURE.

The phenomena produced by stricture vary with the degree an the character of the narrowing. They are most conveniently cla sified under the following headings: 1, subjective symptoms, tho recognizable by the patient; 2, objective symptoms, those elicited b exploration.

SUBJECTIVE SYMPTOMS.—A. *Urethral History.*—Well-planned que tions should elicit the fact that there has been severe or recurre urethritis of long duration; or traumatism to the urethra, perineu or pelvis; or a urethral chancre or chancroid.

B. *Alterations in Micturition.*—1. Frequency. This arises at fir from the change in relation between the expulsive efforts of th bladder and the resistance offered by the urethra; afterwards fro extension of inflammation backward by continuity until the vesic neck is involved; from cystitis; and finally from atony of the bladd with the presence of residual urine. In these cases the frequency worse by day, as in stone, not by night, as in prostatic disease.

2. Changes in the character of the stream, which may be doubl flat, gimlet-shaped, or spray-like, and in tight strictures becomes mu reduced in size, are often of slight significance, as the shape and si

of the stream depend more upon the shape and size of the meatus than upon any condition posterior to it. When the meatus is of good calibre urethral narrowing may remain unnoticed for some time, as a compensatory hypertrophy of the muscular coat of the bladder occurs, which overcomes the effects of the obstruction.

3. Diminution in expulsive power is a late symptom, and is developed only when vesical atony has succeeded to the hypertrophy.

4. Dribbling after urination depends upon the retention of some drops of urine behind the stricture. These escape by gravity after the act of micturition is complete. It is usually an early symptom, caused by irregular action of the circular muscular fibres of the urethra.

The dribbling from the overflow of a distended bladder (incontinence of retention) is a very late symptom, and is associated with a high degree of atony of the bladder.

The incontinence of retention from stricture is at first always worse in the daytime, when the patient is up and about, while the incontinence of retention due to hypertrophy of the prostate is worse at night, when the patient is lying down.

The mechanism of incontinence from stricture is as follows. The dilatation of the urethra behind the stricture having extended to the neck of the bladder, the urinary reservoir becomes funnel-shaped, the bladder representing the base and the stricture the neck. The patient being in the erect position, the weight of the column of urine comes directly on the stricture, which permits it to filter through drop by drop, but when he is reclining the bladder can fill up, and can usually retain its contents unless the changes in it and in the urethra are far advanced. In the prostatic patient it is possible that the congestion of the lumbar cord produced by the recumbent position makes urination more frequent at night and during the early morning hours.

5. Ardor urinæ is very variable, but is not apt to be marked, unless there is a considerable degree of prostato-cystitis present.

6. Retention of urine may occur early and suddenly from an acute increase of the congestion of the mucous membrane in the strictured region, or it may be a late symptom dependent upon the direct obstruction occasioned by the slowly contracting stricture. In either case it is apt to be precipitated by fatigue or cold, or by alcoholic or sexual excess.

7. Vesical tenesmus is generally constant during the entire act of micturition; that of prostatic hypertrophy is most violent at the beginning and grows less as the water begins to flow; that of cystitis is most severe at the end of the act.

C. *Urethral Discharge.*—Opinions vary as to the constancy gleet as a symptom, but it is probable that a large majority of stri tures are accompanied by it. Most of those patients who exhibit discharge show mucous and epithelial shreds and pus-cells in t urine.

D. *Interference with Coition.*—The physiological congestion of ere tion necessarily makes the lumen of a tight stricture still small thus causing retention of semen behind the point of narrowi This may be extremely painful because of the consequent distenti of the urethra, often inflamed and hypersensitive. On subsidence erection the stricture may become sufficiently patulous to allow t semen to drop slowly from the meatus.

If ejaculation takes place at all it is apt to be premature. T erection is often imperfect or subsides before the completion of t act.

E. *Constitutional Symptoms.*—These are late, and depend up vesical and renal changes, with accompanying alterations in the urin They are, therefore, usually a combination of uræmic and septicæm symptoms. There is a red glazed tongue, with anorexia, dyspeps constipation, etc. The dryness of the tongue extends to the walls the pharynx, making swallowing painful; an irregular fever supe venes; the general strength fails, the face becomes pinched a yellow, the eyes sunken, and after rapid emaciation and profou prostration the patient dies comatose.

Of the subjective symptoms *frequent urination*, *dribbling*, and *gl* are the most characteristic of stricture.

Objective Symptoms.—Guyon divides the urethra into six region

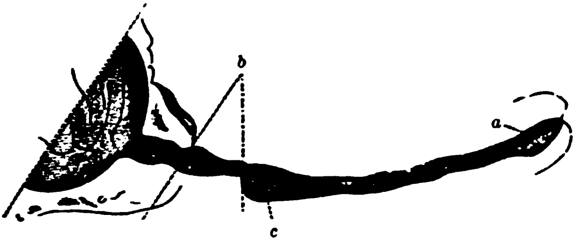
1. The navicular region, extending from the meatus to the coron
2. The penile region, extending from the corona to the peno-scro juncture.
3. The scrotal region, extending from the anterior to the posteri scrotal wall.
4. The perineo-bulbar region, extending from the posterior scro wall to the anterior layer of the triangular ligament.
5. The membranous region.
6. The prostatic region.

It must be remembered that the superior urethral wall alone h anything like a fixed curve, while the inferior wall is only a brok line. The inferior wall is extensible, soft, and depressible, and subject to variations in form and length: hence the important poi for the surgeon to remember during urethral instrumentation is th he should follow exactly the curve of the superior wall, or by manip lations modify the direction of the urethra. The part most susceptible of modification or change in direction is that extending from the suspensory ligament to the entrance into the membranous division; anatomical knowledge and the "touch" must be depended upon to indicate the limit of modification which the urethra will bear without sustaining a lesion. The urethra has no lateral flexions or bends, but lies exactly in the median line. Nothing, however, is easier than to produce such deviation in the spongy urethra, especially in the bulbar portion.

The elasticity and extensibility of the urethra reside for the most part in the spongy portion, as is clearly demonstrated by erection, and this elasticity belongs in the greatest degree to the inferior wall, which permits of easy distention or elongation, while the superior wall yields with much less readiness. This difference increases with age, and is especially marked in the senile urethra. It is therefore evident that since the extensibility of the inferior wall is brought into play by even a moderate force, the surgeon cannot count on its resistance. It glides before an instrument and cannot serve to guide it. It yields readily to a mechanical pressure testing its extensibility; it cannot be incised with any accuracy or precision; it ruptures when surprised by distention. It does not yield equally in all its parts, the perineo-bulbar portion of the canal being the most distensible part of the urethra.

The superior wall is more regular and constant in form and direction, presents the smoother and firmer surface, is less modified by mechanical pressure, offers the greater resistance to rupture and penetration, is less intimately connected with important structures, and is the less vascular, of the two walls.

FIG. 73.

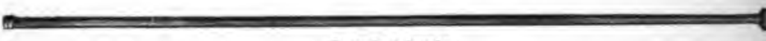


Cast of the urethra. *a*, navicular fossa; *b*, membranous urethra; *c*, expansion of the bulb. (Letzel.)

There are two relatively constricted points in the urethra, the internal and the external meatus, and three dilatations, the fossa navicularis, the bulbar cul-de-sac, and the prostatic expansion, all of which present numerous individual varieties. These dilatations excavated at the expense of the inferior wall of the canal. (Fig. 73

Diagnosis.—The best instruments for the diagnosis of strictur the penile urethra are the so-called bougies à boule or the Otis thrameter. The bulbous bougies may be made of metal, with slen stems, having small expanded ends, upon which the numbe marked; this represents in millimetres the circumference of the at the shoulder. Better instruments, however, are the black flex bougies à boule. (Fig. 74.) The shoulder of the acorn bulb sho join the shaft at almost a right angle, and not at an obtuse angle.

Fig. 74.



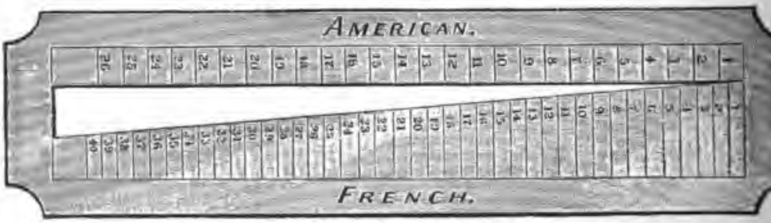
Bougie à boule.

The size of the instrument selected for examination should be termined approximately by noting the circumference of the fla penis at the middle of the spongy portion. (Fig. 75.) The follow is an average scale:

Circumference of	penis,	3 inches;	calibre of	urethra,	26–28	millimetres.
"	"	3¼ "	"	"	28–30	"
"	"	3½ "	"	"	30–32	"
"	"	3¾ "	"	"	32–34	"
"	"	4 "	"	"	34–36	"

The meatus should be cut if it is too small to permit the in duction of a bulbous bougie of the required size.

Fig. 75.



Gauge for urethral instruments.

The penis, with the dorsum facing the abdominal wall, is just behind the corona between the thumb and finger of the left ha the foreskin, if redundant, having been retracted. The bougie, oiled, is then passed gently into the bladder. If it is arrested, point on the shaft corresponding to the meatus is marked with finger and the instrument is withdrawn. The distance from meatus to the bulb of the bougie is then measured, and the region of the contraction is carefully noted. If that instrument or a smaller size passes through to the bladder, it is withdrawn after a moment's delay, and if during its outward passage any contraction is found other than that at the posterior layer of the triangular ligament, it is probably due to stricture, although spasm may occasionally give rise to error in diagnosis.

Spasm cannot always be recognized with certainty. It is generally found at the membranous urethra, and occurs in many diseases of the urinary tract, as in cystitis, in tuberculosis of the bladder or posterior urethra, in phimosis or atresia of the meatus; it also occurs in some rectal and anal troubles, and in spinal congestions and scleroses, as well as in hysteria and neurasthenia.

Gonorrhœal strictures almost invariably give some point of roughening or induration at their favorite seat,—*i.e.*, just anterior to the bulb. In cases of spasm, when the bougie is pushed steadily onward it will continue to be held till it passes through the membranous urethra, while in stricture it is released suddenly. On withdrawing the bougie there should be no resistance at this point from spasm, while in stricture there is an accentuated resistance and the same sudden release on continuing to draw the instrument out. Solid steel sounds if introduced gently nearly always pass without difficulty the narrowing due to spasm. Pain is usually greater in spasm, but this is not sufficiently constant to be of diagnostic value. Uncomplicated deep urethral strictures may be exceedingly difficult to distinguish from narrowing due to spasm of the compressor urethræ muscle, symptomatic of anterior stricture.

As to the diagnosis of stricture of large calibre, even the bougie à boule may be misleading if used in the deep urethra, on account of the normal points of resistance to both its introduction and its withdrawal which are there found, while the urethrameter is similarly misleading in the pendulous urethra, especially if its revelations are interpreted according to the unnecessarily large standard of Otis. In the latter region the normal variations account satisfactorily for the large proportion of strictures found by a few writers and would-be teachers on this subject which may charitably be put down to self-deception. In the deep urethra it has been necessary for them to account for their frequent discovery of strictures, even in cases without the usual etiological factor, by attributing them to masturbation, sexual excess, etc. It has been demonstrated that the "deep-seated stricture usually of large calibre found at the subpubic curvature and its vicinity," and described as "an essential lesion of masturbation"

(Gross), is in reality the point of normal resistance to the withdrawa of bulbous bougies offered by the posterior layer of the triangula ligament.

The prostatic urethra being at once more movable and mor dilatable than the membranous portion, the bulb slips smoothly alon it until the point is reached at which the posterior layer of the tr angular ligament closely embraces the posterior part of the membranous urethra and the outer surface of the prostate. Here, fo obvious reasons, it is arrested, and it is at this moment that the deceptive sensation which may be considered indicative of the existence o organic stricture is communicated to the hand.

A series of observations and dissections upon the cadaver hav proved the soundness of this view, which was originally purely the retical, and, moreover, eliminated the possibility of the resistanc being due to a spasm of the compressor urethræ muscle which su rounds the canal at this point, arrest of the instrument occurring invariably after death as before.[1]

Having in a number of cadavers carefully brought the bulb close up to the point of resistance, it was held in position while the dee urethra was exposed by dissection. The shoulder of the bulb wa always found in the exact locality of the deep layer of the fascia, t edge of which would often be felt tense and cord-like over the upp wall of the urethra. A division on either side of its attachment to t ramus of the ischium, or to the pubis beneath the crura penis, wou then cause an immediate disappearance of the resistance, and the bu could be drawn outward smoothly and uninterruptedly. If the hand of the instrument was depressed during its withdrawal, the edge the prostate became a cause of obstruction; and it may act thus to greater or less extent in all cases.

The recognition of strictures of small calibre is a matter of difficulty. In exploring them it is well to use a medium-sized boug No. 16 or No. 18 French. When this is passed to the anterior surfa of the stricture the region is noted, and its exact calibre determin by using successively smaller instruments. Multiple strictures m be recognized and measured in the same manner. The advantage using a rather large instrument at first is that it eliminates the eleme of spasm in the membranous urethra, which will often, after a litt gentle pressure, allow the blunt rounded point of a medium-siz bougie to pass, while it would contract firmly and persistently befo the point of a fine instrument. By using progressively smaller instr ments also, the stricture can be measured more accurately both in calibre and in situation.

---

[1] Philadelphia Medical Times, May 26, 1877.

Sometimes, when no bougie à boule will pass, a steel sound several sizes larger will do so with ease. The information it conveys is not so accurate as that obtained by exploration with the acorn bougie, but is sufficiently so when the stricture is of small calibre.

In making a diagnosis between deep stricture and hypertrophy of the prostate the history and age of the patient are important factors.

In prostatic hypertrophy the patient is apt to be over fifty years of age, and gives a history of partial retention with nocturnal incontinence of urine; the urethra is lengthened, so that the shaft of a catheter must be entered to an unusual depth and the handle must be more than ordinarily depressed before the beak reaches the bladder; the obstruction will be found at a distance of more than six and a half inches from the meatus, and a finger in the rectum will easily make out the enlarged prostate.

If the points of normal narrowing of the urethra, at the meatus, the middle of the spongy portion, and the membranous portion, are borne in mind, together with the resistance offered by the posterior layer of the triangular ligament to the withdrawal of a bulbous bougie, it is hardly possibie to mistake these narrow areas for stricture.

The presence, location, and calibre of a stricture having been determined, its dilatability is ascertained by the use of the conical steel sound; but it is usually advisable to make this investigation at a second visit.

RESULTS OF STRICTURE.

Unrelieved obstruction of the urethral canal continued for a prolonged period produces, in addition to the local conditions already described, a series of changes in the urinary tract posterior to the lesion. Under long-continued and increasing pressure the urethra gradually enlarges, and the mucous membrane becomes thinned and pouched, projecting in places between the bands of muscular fibres, forming diverticula analogous to those seen in the bladder. Sometimes, instead of permitting the gradual escape of urine through minute openings, with the formation of small abscesses and fistulæ, the urethra gives way more largely at a point behind the stricture, and extravasation of urine follows.

Extravasation of Urine.—This serious complication of stricture is usually preceded by the following symptoms.

Symptoms.—After long continuance of the ordinary phenomena due to stricture a tumor develops somewhat suddenly along the course of the urethra, accompanied by dysuria and frequent mictu tion or by complete retention.

If the extravasation is *gradual*, this tumor will fluctuate, open ternally as an abscess, and form a urethral fistula.

If the extravasation is *sudden*,—*i.e.*, if the wall of limiting infla matory tissue thrown out at first is suddenly broken through by efforts at micturition,—the following symptoms will show the nat of the accident. While straining to evacuate the bladder a sense something having given way is experienced, together with disti relief of bladder tension, although no urine escapes externally. smarting or burning pain is felt about the seat of rupture.

The local symptoms are those produced by the retention of irritant and often a poisonous fluid within the tissues. The parts sv and become œdematous, the color of the skin changes to a dusky purple, or dirty brown, emphysema occurs from the gases of dec position, and spots of gangrene appear. When the urine is se sloughing may set in by the end of the first day.

The general symptoms are those of profound septicæmia, mar by great prostration, irregular temperature, a dry, glazed tongu running pulse, frequent shallow respirations, wandering delirium, finally, if the condition is unrelieved, death in coma. These deve with greater intensity and rapidity if the bladder has been infected putrefactive microbes and the urine is therefore fetid and purul before extravasation takes place.

The localizing symptoms—those which indicate the point at wh the urethra has given way—are based upon the course taken by urine.

A. In case the pendulous urethra gives way, the result may b follows:

1. When the urine is not septic and ammoniacal, and the extra sation is not very rapid, it may remain strictly limited, forming a b internal fistula.

2. The urine extravasates into the substance of the corpus sp giosum, passing forward in the course of the urethra, and finally volving the glans penis in the sloughing process. Brodie states the appearance of a black spot on the glans penis after extravasa is a fatal sign, and Harrison concurs in this opinion.

3. The corpus spongiosum may be protected by inflammat exudate, ulceration extending to, but not through, its strong fibr envelope (Buck's fascia). In this case the urine may burrow forw forming a long, indurated, fistulous tract, opening externally beh the glans, or on the dorsal surface near the root of the penis.

4. Ulceration involves the common fascia of the penis at or near the point of rupture. In this case the loose cellular subcutaneous tissue of the penis becomes enormously œdematous, the swelling extending backward to the scrotum. This is the common course when rapid extravasation takes place from the pendulous urethra.

B. When extravasation occurs from any portion of the urethra included between the attachment of the scrotum and the anterior layer of the triangular ligament, usually the bulbar portion, the course of the extravasated urine is governed by the attachments of the deep layer of the superficial fascia,—Colles's fascia. The urine will first occupy the space enclosed by this fascia in front and below and by the anterior layer of the triangular ligament behind, and, as it cannot reach the ischio-rectal space on account of the attachment of the fascia to the base of the ligament, and cannot reach the thighs on account of the insertion of the fascia into the ischio-pubic line, it is directed into the scrotal tissues, and thence up between the pubic spine and the symphysis until it reaches the abdominal wall.

C. In case the membranous urethra gives way, the extravasated urine is confined to the region included between the layers of the triangular ligament, and gains access to other parts only after suppuration and sloughing have made for it an outlet. The symptoms following will then depend upon the portion of the aponeurotic wall which first gives way. If the anterior layer of the triangular ligament yields, the extravasation will take the course described as characteristic of extravasation from the bulbous urethra; if the posterior layer yields, the course of the urine will correspond with that taken when the prostatic urethra is ruptured.

D. If the opening is situated behind the posterior layer of the triangular ligament—in the prostatic urethra—the urine may either follow the course of the rectum and make its appearance in the anal perineum, or, as it is separated from the pelvis only by the thin pelvic fascia, it may make its way through the latter near the pubo-prostatic ligament, where the fascia is especially weak, and may spread rapidly through the subperitoneal connective tissue, sometimes forming abscesses in the hypogastric region.

The usual source of extravasation is from the bulbous and the membranous urethra, the urine infiltrating the perineum and scrotum and mounting upward to the belly-walls. When extravasation occurs from the membranous urethra the anterior layer of the triangular ligament nearly always gives way.

Prognosis.—The prognosis of extravasation of urine, except in those few cases where inflammatory reaction protects the surrounding tissues and where local abscesses and fistulæ are formed, always grave. When the penile urethra is involved the skin usua ulcerates, thus allowing escape of urine before the extravasation h become wide-spread. Extravasation into the substance of the cor cavernosum is fortunately rare.

In extravasation from the bulbous or membranous urethra th is little prospect of spontaneous relief being afforded by ulceratio hence prompt interference is necessary to prevent wide-spread slou ing and death from septic poisoning.

Extravasation from the prostatic urethra, and extravasation fr the membranous urethra, with backward extension through the p terior layer of the triangular ligament, are the most dangerous for of this complication of stricture, since the symptoms are not so ch acteristic that immediate diagnosis can be made, and since it is di cult to drain the infected tissues thoroughly when the infiltration fairly started.

Treatment.—The treatment of extravasation of urine is sufficien simple in theory. The two indications are prevention of further travasation, and thorough drainage.

Further extravasation is prevented by external perineal urethr omy or perineal section. Usually an instrument can be passed, breach in the urethral wall being upon the floor of this channel a not very large.

At the same time that the urethra is opened behind the strict the latter should be thoroughly divided. The entire infiltrated a is drained by long multiple incisions; it is scarcely possible to over this part of the operation. Two cuts are required for the scrotu two or three for the penis, and, if the case has lasted more th twenty-four hours, three or four for the abdominal walls. As mu of the extravasated urine as possible should be squeezed out throu these cuts by vigorous mechanical pressure, and the tissues should washed with bichloride 1 to 4000. The cuts should be dressed w iodoform, loosely packed with iodoform gauze, and covered with antiseptic fomentations, changed every two hours (twenty layers gauze wrung out in bichloride 1 to 4000 and covered with oiled silk

When the prostatic urethra gives way, external perineal urethr omy and drainage may not suffice. If the infiltration has been tensive, the parietal incision for suprapubic cystotomy will also required, the prevesical space being irrigated and drained. By digi examination through the rectum, boggy or indurated areas can detected about the base of the bladder, and must be opened a drained through the perineum.

Bladder.—The bladder becomes affected as the stricture narrows. Occasionally, when the obstruction occurs suddenly, the walls are at once thinned and atrophied by overdistention. As a rule, however, a compensatory hypertrophy takes place first, the muscles become thick and rigid, the capacity of the viscus diminishes, and the muscular fibres stand out in bars or ridges, having between them lozenge-shaped spaces where the walls are greatly thinned. During the frequent and violent contractions of the viscus the mucous membrane is driven outward between these muscular partitions, and the bladder finally becomes pouched at a number of places.

Usually there is also a severe cystitis developed by infection through the urethra and adding greatly to the severity of the symptoms. Exceptionally the sacculi rupture, causing collapse and death.

Ureters.—The ureters become dilated partly from the actual backward pressure of the column of urine incident to distention of the bladder, and partly from the frequent compression of their vesical ends during the oft-repeated acts of urination. Their oblique course through the walls of the bladder renders this compression very effective, and hydronephrosis is developed, causing mechanical obstruction to the secretion of urine.

Kidneys.—Sooner or later microbic infection takes place, and the renal alterations due to suppurative inflammation follow. A pyelonephritis first develops, and then foci of suppuration are formed at different points through the cortex and beneath the capsule, until finally the kidney is converted into a large abscess-cavity, or into a series of pus-containing sacs, held together by the capsule and inflammatory lymph, and showing no trace of the secreting structure. This condition is called surgical kidney.

Among the possible results of stricture may be mentioned vesical calculus, impotence, sterility, recto-vesical fistula, and very rarely spinal sclerosis or some of the forms of cerebral disease.

Prognosis of Stricture.—The prognosis as to life depends, of course, on the stage which has been reached and upon the estimate which may be formed of the secondary organic changes that have already taken place. Relief of the obstruction, drainage and antisepsis of the bladder, milk diet, renal antisepsis, etc., often work astonishing changes in apparently desperate cases.

Fenwick has forcibly called attention to the fact that in the practical treatment of stricture we too often concern ourselves merely with the mechanical removal of the obstruction, and do not pause to ascertain to what extent the secreting structure of the kidney has been weakened or rendered susceptible to the invasion of infla mation from continuous surfaces.

Fenwick emphasizes the fact that in the obstruction offered to overflow of urine by unrelieved stricture three muscular system the vesical, the ureteric, and the cardiac—become successively affec with hypertrophy. He finds that residual urine exists in varying p portions in ninety-three per cent. of cases of stricture, and reac the following conclusions:

1. In estimating the health of the kidneys from the indications forded us by the examination of the residual urine, the amount of pre ure which the kidneys have been working against must be remember This is to be measured by the quantity of residual urine. It may safely assumed that five ounces of residual urine, which is probably n the average of unreleased narrow strictures, would indicate suffici damage to cause anxiety as to the effects of any intercurrent inflamı tion or disease, while an amount over ten ounces would make us c tious in operating for stricture by internal urethrotomy, and in giv anything but a grave prognosis of the ultimate effects of the constricti

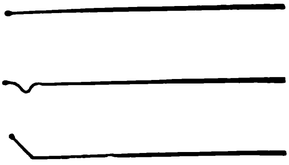
2. The behavior of the muscles in their progress towards recov will teach us much as regards the future course of the case. A position to relapse or sluggishness in recuperation would cause us look forward with apprehension to that period of life when fatty senile changes will step in to aggravate greatly the weakness of organ upon the condition of which comfort and health in old age mainly dependent.

3. We are amply justified, when the initial amount of residual u is under five ounces, and when recovery of the normal calibre is pron in giving a good prognosis, provided the full calibre of the urethr maintained.

TREATMENT OF ORGANIC STRICTURE.

The various methods employed in the treatment of stricture n be divided into: 1, DILATATION: *a*, gradual; *b*, continuous; 2, INT NAL UTETHROTOMY; 3, EXTERNAL URETHR OMY; 4, COMBINED INTERNAL AND EXTER URETHROTOMY; 5, PERINEAL SECTION; 6, CELLANEOUS METHODS, including divulsi rapid dilatation, electrolysis, excision, ur rectomy, etc.

FIG. 76.

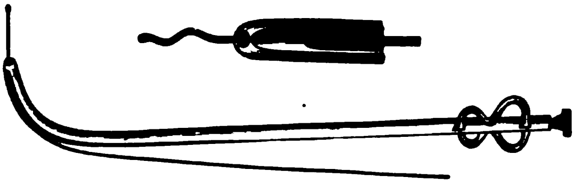


Filiform bougies.

Gradual Dilatation.—The ins ments for the gradual dilatation of strict consist of a set of whalebone filiform bougies with straight, angu and spiral ends (Fig. 76); a set of tunnelled catheters, ranging fr

No. 8 or 10 to No. 18 French (Fig. 77); a set of Thompson's conical steel sounds, running from No. 12 to No. 36 French (Fig. 78); and

FIG. 77.



Tunnelled catheter. Enlargement of tip showing position of tunnel.

some flexible bougies of different sizes,—acorn, conical, and bulbous or olive-tipped. The flexible bougies should be so constructed that

FIG. 78.

Steel sound.

the portion just behind the tip is sufficiently yielding to allow the latter to follow the sinuosities of a tortuous stricture. Slight pressure upon the end of such a bougie should cause flexion of the neck. The English bougies are objectionable because they are not made sufficiently flexible near the tip. The steel instruments should be absolutely free from rust or any surface roughness. The flexible bougies should be smooth, strong, and without cracks.

In selecting filiform bougies great care should be exercised, since many of these instruments are improperly constructed or have been kept so long that they are brittle and dangerous. The end of the instrument should be bulbous and the tapering neck should be flexible yet tough. The surgeon should be able with his thumb-nail to angle the last half inch of the instrument without breaking any of its fibres, and whilst flexible its shaft should be sufficiently stiff to allow of a push on the handle being transmitted to its tip. Though the conical steel sounds are commonly used in the curative treatment of structures of large calibre, the woven bougies with lead core bulbous tip and *flexible neck behind this tip* are at times invaluable. This is particularly the case when the opening of the structure is eccentric and is complicated by an unusual degree of spasm of the compressor urethral muscle. The flexible instrument under such circumstances allows of easy penetration with the least possible amount of traumatism, and can often be passed without difficulty when the introduction of steel sounds is impossib These instruments should be carefully tested on purchase to see th extreme flexibility is present at the portion where it is most needed, that is, in the narrowed portion just behind the bulbous extremity.

Cleansing of Instruments.—The principles of urethral antisepsis mu be rigorously applied in the care of these instruments. (See page 27

Cleansing of the Urethra.—In cases requiring the use of sounds t meatus and its immediate environment, together with the urethr are often swarming with pyogenic organisms, which, gaining entran to the system through slight cracks or through abrasions incident the passage of the instrument, may occasion violent inflammati with its sometimes serious local and general sequelæ. To lessen t danger as far as possible, the glans and foreskin should be thorough cleansed by means of pledgets of cotton wet with bichloride of m cury 1 to 1000. In women it is particularly important thoroughly cleanse the region about the urinary meatus before passing an instr ment into the bladder: hence catheterization by touch alone is to discouraged.

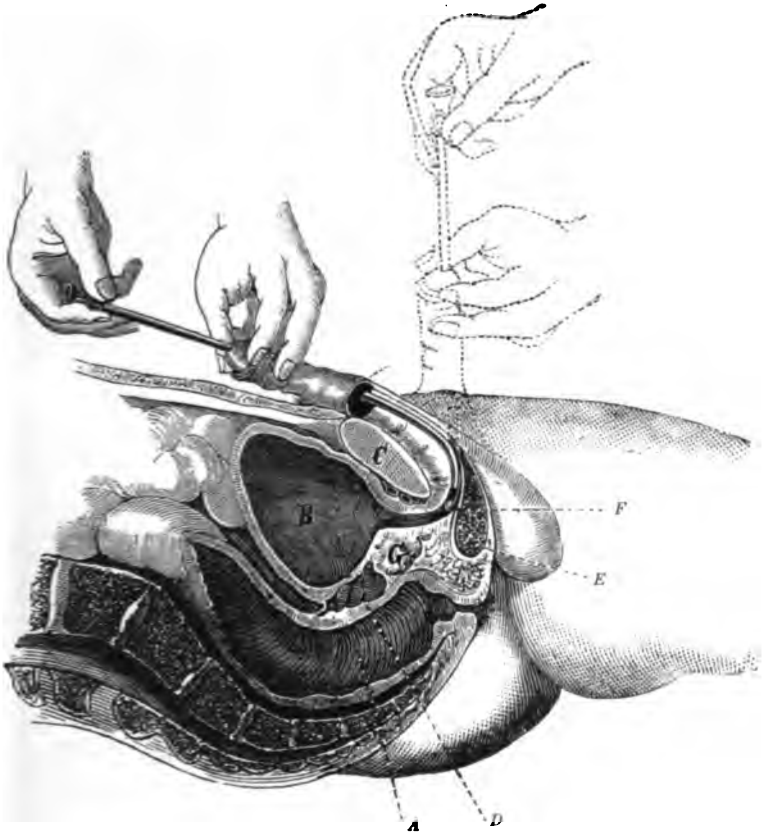
The urethra should be flushed of purulent contents by directi the patient while micturating forcibly to stop the stream abruptly sudden closure of the meatus with the finger. When there is fr muco-purulent discharge, the whole urethra should receive an an septic irrigation, either by means of injections thrown in by an ordina syringe, by a small soft rubber catheter attached to a fountain syrin passed beyond the stricture and very slowly withdrawn while t antiseptic fluid is flowing, or by the irrigating bag and short ureth nozzle.

When the bladder has been infected, if the urethra is permeab it is best to precede the systematic treatment of stricture by irrigati with some antiseptic solution, as sublimate (from 1 to 20,000 to 1 10,000), potassium permanganate (1 to 5000 to 1 to 1000), boric ac (fifteen grains to the ounce of boiled water), protargol (1 to 2000 1 to 200), or silver nitrate (from 1 to 5000 to 1 to 500). At the sa time, when the stomach permits, it is important to administer an septic drugs, such as salol and boric acid, in from five- to ten-gra doses, from four to six times daily.

These preliminaries having been attended to, the entire ureth having been anæsthetized by instillations (see page 159) of a four p cent. eucaine solution, and the stricture having been located, a conic steel sound, two sizes larger than the bulb which has passed the str ture, is warmed and sterilized by flaming it with alcohol, lubricate and carefully introduced through the stricture.

The fixed curve of the urethra—*i.e.*, the curve assumed by the majority of adult urethras in a condition of rest—is measured from just in front of the triangular ligament to the neck of the bladder. (Fig. 79.) It is theoretically considered as that part of a circle of three and one-quarter inches' diameter which is subtended by a chord two and three-quarters inches long. (Fig. 80.) Practically this curve varies greatly from this standard. Indeed, it is not a continuous curve. Depressing the urethra by means of a finger placed on either side of the root of the penis somewhat straightens this curve. It is always lengthened by hypertrophy of the prostate or a much distended bladder. It may be temporarily obliterated by passing a straight instrument into the bladder. (Fig. 81.)

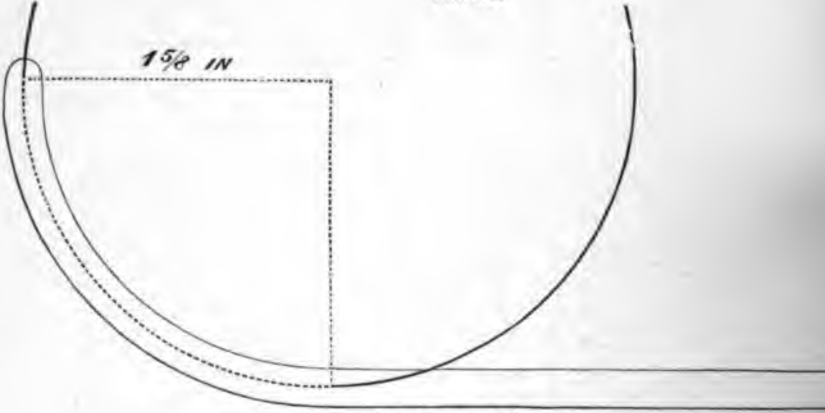
FIG. 79.



Tip of catheter just entering the fixed curve of the urethra. (Antal.) *A*, rectum; *B*, bladder; *C*, symphysis pubis; *D*, seminal vesicle; *E*, bulb; *F*, tip of instrument entering the fixed curve of the urethra; *G*, prostate.

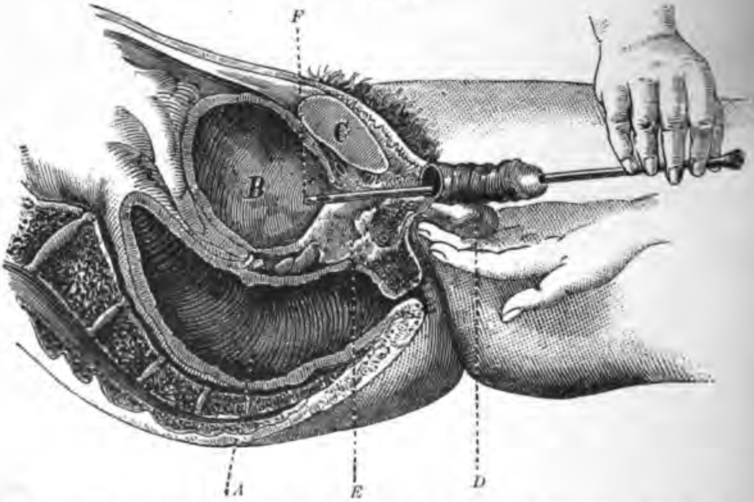
Passing the Sound.—For the passage of a properly made sound or silver catheter, the curve of which corresponds with given above, the patient should be placed in the recumbent posi with the head and shoulders slightly elevated, the knees a separated, and the muscles relaxed. The surgeon, if right-han stands at the left side of the patient. The sound or catheter, ha been previously sterilized, warmed, and lubricated, is taken in right hand, and, the foreskin having been retracted, the peni

Fig. 80.



Fixed urethral curve.

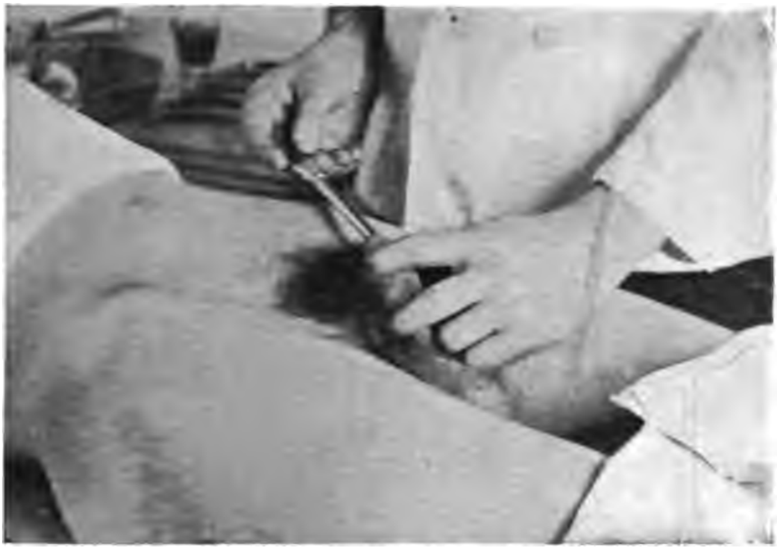
Fig. 81.



Fixed curve of the urethra obliterated by the passage of a straight instrument. (Antal.) *A*, re *B*, bladder; *C*, symphysis pubis; *D*, scrotum; *E*, prostate; *F*, tip of catheter in bladder.

held between the middle and ring fingers of the left hand. The organ is gently put on the stretch, care being taken to keep the dorsum towards the abdominal wall, so as to avoid making twists in the urethra, the lips of the meatus are separated by the thumb and finger of the left hand, and the tip of the instrument is passed into the urethra. At this time the shaft of the sound or catheter should be parallel to the line of the groin. (Fig. 82.) This is important

FIG. 82.

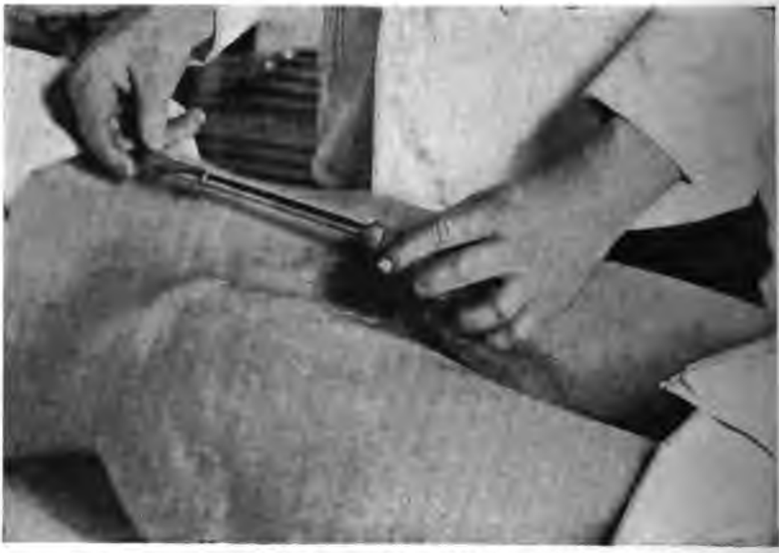


Passing the sound. The shaft is parallel with Poupart's ligament; the tip has entered the urethra.

chiefly in persons with large, protuberant bellies, in whom, if this rule is not followed, the tip of the instrument will be made to catch against the anterior layer of the triangular ligament, owing to the elevation of the handle necessitated by the prominent abdomen. In any event the handle of the instrument must be kept low until the tip is about to enter the membranous urethra. Having engaged the point of the sound, the penis is now drawn up with the left hand, while the instrument is gradually pushed onward, until three or four inches of the shaft have disappeared, when the handle is swept inward to the median line, the shaft being kept parallel to the anterior plane of the body and nearly touching the abdomen. (Fig. 83.) The shaft of the instrument is now pushed downward towards the feet, and as soon as this motion is arrested the fingers of the left hand are removed from their hold on the penis and shifted to the perineum, where the curve of the instrument is felt behind the scrotum. (Fig. 84.) The

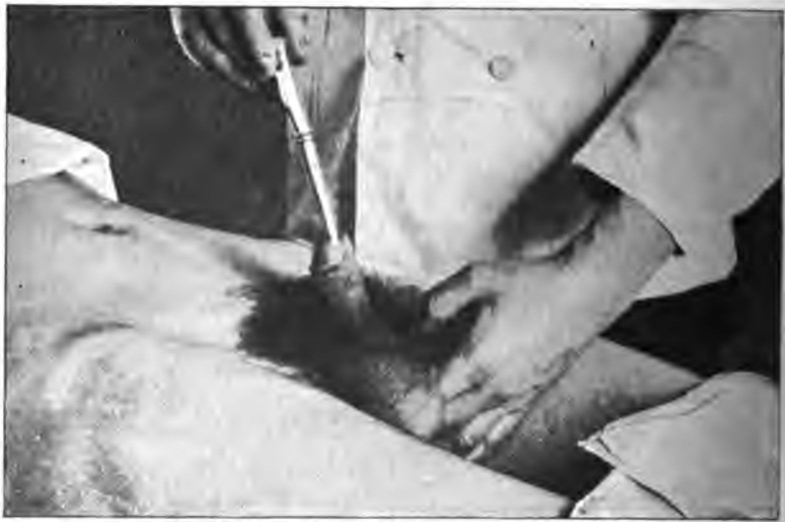
handle is then, and not till then, raised from the abdominal wall ar
swept gently over in the median line, while the left hand acts as

FIG. 83.



Passing the sound. The shaft is carried inward to the middle line of the body.

FIG. 84.

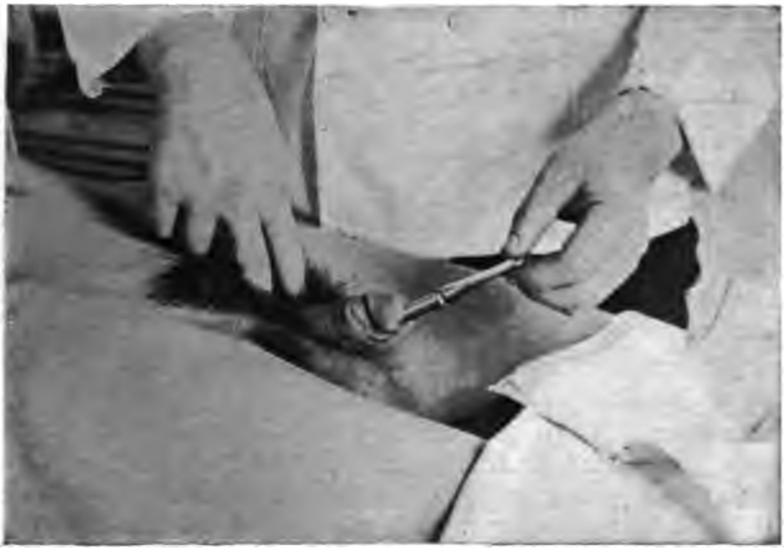


Passing the sound. The shaft of the instrument swept upward; the fingers of the left hand plac
against the perineum.

fulcrum over which the instrument glides. After the shaft has pass
the perpendicular, the handle is taken in the left hand, and the ind

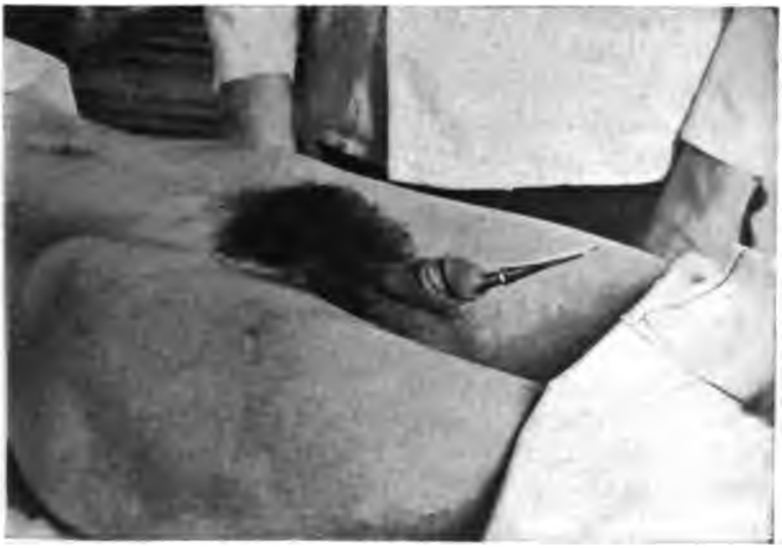
and middle fingers of the right hand are placed one on either side of the root of the penis, making downward pressure, while the left hand

FIG. 85.



Passing the sound. The handle taken in the left hand, the fingers of the right hand making downward pressure at the root of the penis.

FIG. 86.



Position of sound, showing that its tip has entered the bladder.

depresses the handle between the legs, carrying the point of the instrument through the membranous and the prostatic urethra into the bladder. (Fig. 85.) The entrance into this organ is recognized the free motion of the tip of the sound when the handle is rotat and by the fact that the instrument remains exactly in the medi line and points away from the pubes when the hold upon it is laxed. (Fig. 86.) The whole manœuvre must be effected with gent ness; no force is necessary.

If there is a spasm of the circular muscular fibres of the ureth at any point, or of the compressor urethræ at the bulbo-membran juncture, gentle steady pressure for a minute or two usually will followed by relaxation.

If the handle is lifted too soon from its proximity to the abdomi wall, the tip of the instrument catches in the subpubic ligament ab the urethral orifice; if the handle is not raised soon enough, or if fingers on the perineum do not give the curve of the instrument gentle upward pressure that it needs, the tip buries itself in the lo and movable floor of the bulbous urethra below the orifice of membranous portion of the canal. (See Fig. 73.) In either case curve of the sound protrudes unnaturally in the perineum. T withdrawal of the instrument for an inch or two and its reintrod tion, raising or lowering the tip as may be required, will suffice overcome the obstacle.

If the instrument is used with ordinary care and gentleness a has been properly sterilized, and if it is immediately followed by a to antiseptic irrigation (protargol 1 to 2000 to 1 to 200), the product of prostatitis, epididymitis, or urethral fever will follow with extre rarity. In a majority of cases these complications are due to the of force in the introduction of the bougie, when the instrument pr tically becomes a divulsor, or to a slovenly disregard of antisep either the instruments not having been sterilized or the urethra having received antiseptic irrigation before manipulation.

Sometimes a few drops of blood follow the withdrawal of the strument, the next act of urination may be slightly painful, and of the gleety discharge will increase for a day or two.

The method of treating stricture by gradual dilatation consists the passage of sounds of increasing gauge at intervals of from three five days, till the stricture readily admits an instrument correspond in size to the normal calibre of the urethra.

Each sounding is followed by a slight and transitory hyperæ of the region about the stricture, and during this time, particularly recent cases, an appreciable softening and absorption of the strict tissue may occur. This period lasts from three to four days, and until it subsides is the passage of an instrument to be repeated.

Ordinarily an advance of one or two numbers of the French scale may be made each time, but occasionally the same instrument must be introduced at several sittings before it can be exchanged for a larger one. This is determined by the degree of resistance experienced during its introduction, the pain which it excites at the time and afterwards, and the presence or absence of bleeding. Personal experience soon becomes the best guide as to the degree to which dilatation may be carried at any one sitting, though the feelings of the patient should always be consulted. When the full size has been reached (*vide* table, page 220) the symptoms will usually disappear, and after this it is only necessary to carry on the dilatation at increasingly longer intervals to maintain the calibre of the urethra. If the patient is of average intelligence, it is easy to teach him to pass an instrument on himself without the least discomfort or inconvenience.

A certain proportion of cases under this plan of treatment will get entirely well, so that years afterwards no trace of stricture can be discovered. Others, if the intervals between the introduction of the sound are too long, will have a slight recontraction, evidenced possibly by a recurrent gleet, and the treatment will have to be repeated.

The introduction of a sound into any stricture which it fills without causing laceration is accompanied by certain phenomena. There is felt, at the end of a minute or two, a difficulty in withdrawing the instrument. Soon the spasm disappears, and movement of the sound becomes easy again. Some hours later a muco-purulent discharge is established in the canal, and in a few days the stricture allows the passage of a larger sound. The permanent enlargement obtained is principally due to absorption incident to the congestion excited in the stricture by the presence of the foreign body, and not to the mechanical dilatation and pressure of the sound. Therefore, when it is desired to make this inflammation a little more severe, it is well to leave the sound *in situ* for five or ten minutes. The point may be withdrawn a little during this time, to avoid irritation of the prostato-vesical region. The effect of sounds of gradually increasing size is to stimulate the work of absorption and to cause the contractile elements to atrophy and the urethra to resume approximately its normal character.

These remarks apply to all strictures, except those complicated with abscesses, fistulæ, urinary extravasation, etc., or those in which there is marked resiliency, or where instrumentation is followed by rigors and urethral fever.

All surgeons are agreed that *uncomplicated strictures of large calibre should be treated by gradual dilatation when they are at or behind the* *bulbo-membranous juncture.* The treatment is, however, rejected b some surgeons in favor of the cutting operation when such strictur of the pendulous urethra are encountered.

A review of a large number of reported cases of internal urethro omy, and familiarity with a considerable number even less favorab and not reported, lead us to believe that these figures rather unde estimate the mortality, and that the practitioner who decides to cut stricture anterior to the bulbo-membranous juncture must do so wi the full knowledge that there are at the very least two chances the hundred of losing his patient. There should certainly be defini and well-grounded reasons for accepting this risk, and the operatio which involves it should show results unmistakably superior to tho of gradual dilatation,—a procedure with practically no mortality.

It is not in accord with other pathological observations to suppo that the mere division of a dense and old contractile band of fibro tissue will result in its absorption, and it is highly probable that t majority of the true strictures of the spongy urethra which are cur by internal urethrotomy are those in which the division of the stri ture is supplemented by the use for some time of full-sized bougie The relief of tension afforded by the section of the stricture gives f play to the so-called "inflammatory atrophic dilatation," and in certain proportion of cases either retrograde metamorphosis a absorption take place, or there are at least a thinning and weakeni of the fibrous band, which result in its practical disappearance as cause of obstruction.

It is also probable, on both clinical and pathological grounds, th the great majority of so-called strictures of the pendulous ureth which are cut by the extremists in urethrotomy are points of physi logical narrowing, and that the so-called "cures" are merely illustr tions of the fact that by a linear incision into its long axis we can p in the normal urethra a longitudinal splice of fairly healthy tiss which has little tendency to contract afterwards, and can thus mo or less permanently enlarge the urethral calibre.

It is difficult to see, however, why such a splice should preve the steady contraction of a mass of old cicatricial tissue, such as occ pies the wall of the canal and the periurethral space in strictures some standing.

STRICTURES OF SMALL CALIBRE.—The diagnosis of *stricture of sm calibre* (less than 15 French), situated at or deeper than the bulb membranous juncture, is made either with the bulbous bougie, if th can be passed through, or by the introduction of a sound down to t anterior face of the contraction. Such strictures are usually accon panied by gleet and marked vesical symptoms, increasing in severity with the tightness of the contraction.

The choice of treatment lies between dilatation and some form of urethrotomy. Divulsion is so clumsy, so uncertain, and so dangerous as to have almost no advocates to-day.

In beginning the treatment of a stricture of small calibre it is best to pass through it a steel sound, provided its introduction requires no force. It is not safe to use a sound smaller than No. 8 or No. 10 of the French scale, as even in the most skilful and experienced hands there is an unavoidable danger of lacerating the inflamed and degenerated mucous membrane around the strictured region. It is in the exploration of deep stricture of small calibre that "false passages" are usually made, and almost always with small metallic instruments, either sounds or catheters. The mucous membrane in front of a tight stricture is generally inflamed and softened, and if fistulæ have formed behind the stricture, diverting the course of the urine, the anterior portion of the strictured region undergoes atrophy, as it is no longer subject to constant irritation, and a thin-walled dilatation is frequently found there, which offers but little resistance to the point of an instrument.

When a *false passage* is made, the sensation conveyed to the hand differs markedly from that attending a successful catheterization. The point of the instrument is not in the median line, and is held with unusual firmness. There is free bleeding almost immediately; the finger in the rectum will detect the deflection of the instrument, and the absence of the normal thickness of urethral and prostatic tissue beneath its curve. If there is no retention of urine, the immediate treatment after making a false passage consists in rest in bed, urethral and urinary antisepsis, continuous catheterization for some days, and the avoidance of further instrumentation for some weeks. Should perineal abscess or urinary infiltration follow, prompt incision is indicated.

If a sound is passed through a stricture of small calibre, it should remain five or ten minutes, and then be withdrawn. If it is the first experience with the patient, it is best to wait three or four days before passing an instrument again, in the mean time administering five-grain doses of salol or boric acid four to six times daily, with a full dose of quinine morning and evening. At the next sitting it is well to recommence with the same instrument, after which one, two, or three larger sizes may be used in succession, provided their introduction is easy and not accompanied by pain or bleeding. Hemorrhage and pain are indications for lengthening the intervals between treatments and for proceeding more slowly in the use of larger instruments.

Once fairly established, however, the treatment by dilatation carried on until the full normal calibre is reached: usually this requir from three to six weeks.

If the stricture is not resilient or irritable, and is not traumatic its origin, it will be found that all symptoms have disappeared, unle perhaps the gleet persists for a time. This, too, will often subsid but, in view of the extensive and serious urethral lesions alwa associated with long-standing stricture, it is apparent that gleet m persist in spite of full dilatation, even though it is reinforced by mo careful local and general treatment.

When the stricture is a recent one, absorption may take plac but in any event the occasional introduction of a steel sound by t patient will always keep the case under control.

In cases of *resilient*, *irritable*, or *traumatic* stricture of the bulb membranous region, external perineal urethrotomy is the operati of choice. Similar strictures of the penile urethra should be treat by internal urethrotomy.

STRICTURES OF SMALL CALIBRE PERMEABLE ONLY TO FILIFORM BOUGIES.- In certain cases no steel sound or ordinary soft instrument can made to pass the stricture, but a persevering trial with whalebo filiform bougies will result in the passage of one into the bladd This trial should be made persistently and patiently, and in the a sence of retention of urine may be frequently repeated. After anæ thetizing the urethra and relieving local congestion by an instillati of adrenalin chloride, 1 to 2000 in a four per cent. eucaine solution, t urethra is slightly overdistended anterior to the stricture by carboliz oil injected by means of a piston syringe. A filiform is passed do to the stricture, and if, after patient, gentle effort, it refuses to enter, is withdrawn, and is given an angle of forty-five degrees by bending across the thumb-nail at about a quarter of an inch from the en (Fig. 76.) As the orifice of a tight stricture is frequently not in t middle of the obstructed urethra, but at some point around its c cumference, this manœuvre will often enable the surgeon to enter when with a perfectly straight instrument he cannot do so. If th does not succeed, several filiforms are passed by the side of the fir one, to impinge on the irregular surface of the stricture at a number points; then by attempting to pass first one and then another of the the filiform bearing the right relation to the orifice will usually be fou and can be introduced into the bladder. If this fails and one filifor can merely be engaged in the stricture, it is often best, in the absen of retention, to tie it in place and allow it to remain for twenty-fo hours. In the great majority of cases at the end of this time it ca be passed through the stricture. After the first instrument is introduced, four courses are open to the surgeon.

A. *Continuous Dilatation.*—1. The filiform may remain in place, with the certainty that in one or two days others may be slipped alongside of it, and may be used as guides for the introduction first of a tunnelled catheter and later of an ordinary soft or steel instrument.

2. An immediate attempt may be made to pass into the bladder a tunnelled catheter, and if successful leaving it to act for twenty-four hours by continuous dilatation; later, gradual dilatation may be employed.

B. *Urethrotomy.*—3. A tunnelled and grooved staff may be passed over the filiform, and external urethrotomy may be performed.

4. The filiform may be used as a guide for a Maisonneuve urethrotome, and internal urethrotomy may be performed.

If the stricture which is being dealt with is not of traumatic origin, and is not specially resilient or irritable, the first method will lead to the adoption of gradual dilatation with the greatest degree of comfort and absence of anxiety to both the patient and the surgeon. Even if there has been moderate retention, it is certain that the urine will pass with increasing freedom by the side of the filiform, and that the danger of the case is over so far as retention is concerned.

If retention has been complete for many hours and it is necessary to give immediate relief to the overstretched bladder-walls, it is best to adopt the second method,—that is, pass a catheter at once. Failing in this, the third method, or external perineal urethrotomy, should be employed. In all deep strictures when instrumentation occasions rigors the external cutting operation is indicated.

Internal urethrotomy is practised in cases of tight, bulbo-membranous stricture complicated by retention only when the patient refuses to have the external operation performed. In the best hands it is attended with a distinctly larger mortality than any of the other methods mentioned, and there is no evidence that it is followed by any larger percentage of permanent cures.

While gradual dilatation is the preferable treatment in the great majority of cases, there are a number of strictures in which it is not applicable, and which are best treated by other methods.

URETHROTOMY.

A stricture may be divided entirely from within the urethra, in which case the operation is termed INTERNAL URETHROTOMY; it may be divided by an incision carried through the overlying integument and fascia,—EXTERNAL URETHROTOMY; or both of these methods may be employed,—COMBINED INTERNAL AND EXTERNAL URETHROTOMY.

Internal Urethrotomy.—The different methods employed the internal division of stricture depend upon the direction and loc tion of the incision. This may be made (*a*) from before backward (*b*) from behind forward; (*c*) on the roof or (*d*) on the floor of t urethra.

For operations on narrowings of the meatus or those placed with the navicular portion of the urethra an ordinary blunt-pointed ten tome with a convex cutting edge is all that is required. But for oper tions at a greater depth a number of instruments have been devise for each of which some special merit is claimed.

In cutting strictures at or anterior to the bulb the incision is ma in the roof of the urethra, except at the meatus, where the incision as a rule, made on the floor. The division of stricture of the mer branous urethra is less liable to be attended with troublesome hemo rhage if the incision is made on the urethral floor. Gonorrho strictures are fortunately not frequent in this portion of the canal.

If the hemorrhage is not controlled by the catheter alone, a fir bandage should be applied to the penis, or, if the point of cutting too deep to be reached in this way, pressure may be applied to t perineum by a compress placed over the seat of operation and t application of a crossed of the perineum. For the temporary arre of active hemorrhage perineal pressure applied by a padded cane, t ferrule of which is braced against the foot-board of the bed, will found efficient, or digital compression may be made by an attendan

The *antiseptic details required in internal urethrotomy* are as f lows. For from five to seven days before operation salol and bo acid should be given by the mouth,—five grains of the former a ten grains of the latter four times daily. This is particularly in cated when cystitis is present and the urine is infected. The ureth is rendered as surgically clean as possible by previous irrigati repeated night and morning for several days before operation, wi a final washing just before the introduction of the urethroton The solutions used are normal saline, a 1 to 4000 lotion of potassiu permanganate, a 1 to 5000 solution of silver nitrate, or a 1 to 10 protargol solution. If the stricture is permeable, a soft catheter small calibre is passed behind it and the whole urethra is flushed with the cleansing lotion, from eight ounces to a pint being used ea time; or the washing is conducted with the gravity bag and sh urethral nozzle. The instrument employed is boiled in soda soluti (one per cent.) for ten minutes before it is used.

After the stricture is divided, a full-sized soft rubber catheter passed into the bladder and retained there for twenty-four hours.

it is withdrawn, a 1 to 2000 protargol lotion is allowed to flow through it, thus flushing the urethra and cleansing the seat of operation. The catheter should be a new one, and should be disinfected by boiling immediately before operation.

INDICATIONS FOR THE PERFORMANCE OF INTERNAL URETHROTOMY.—This operation is indicated: 1. In all strictures at or near the meatus.

2. In fibrous, resilient, or irritable strictures of large calibre anterior to the bulbo-membranous juncture.

3. In strictures of small calibre situated in advance of the bulbo-membranous juncture, except when such strictures are very recent, soft, and dilatable.

Or, still further to simplify the indications, it may be stated that all fibrous, resilient, or irritable strictures anterior to the bulbo-membranous juncture should be treated by internal urethrotomy.

Resiliency and resistance to dilatation are the chief indications for preferring the cutting operation in the treatment of strictures of any portion of the urethral tract: hence, even though the coarctations are of large calibre, if they are distinctly resilient or fibrous urethrotomy is indicated.

Strictures of small calibre situated in advance of the bulbo-membranous juncture, unless seen very early and found to be soft and dilatable, furnish the typical condition for internal urethrotomy. In such cases the operation is attended with the greatest prospect of a permanent cure. The exceptions to this rule will be given in the section devoted to combined internal and external urethrotomy.

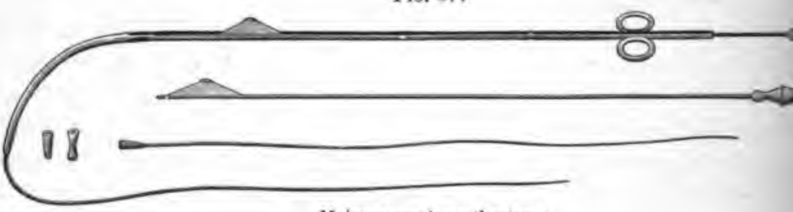
For strictures of the meatus and in the neighborhood of the fossa navicularis dilatation is peculiarly unsatisfactory, since the excessive sensibility of this part and the intimate relation between the spongy tissue of the glans and the urethra make stretching painful and render inflammatory reaction unduly severe.

The incision is made on the floor of the urethra, and should be sufficiently deep to remove all sense of resistance upon the withdrawal of a bulbous bougie two numbers larger than the normal urethral calibre, since there is always slight contraction in healing. A ten per cent. solution of cocaine, applied by means of a pledget of cotton wrapped on a match-stick dipped in the solution, passed into the meatus and held in place for two minutes, will render the operation entirely painless. The incision should be made exactly in the middle line, and bleeding may be checked by packing the navicular fossa with iodoform gauze. A short straight conical bougie of full size, the so-called meatus sound (Fig. 64), should be gently inserted once daily during the healing process. Applications of cocaine render this

procedure practically painless, and also relieve the ardor urinæ
which some patients complain. Deeper-seated troubles, unless ur
in their character, should be ignored until the healing is complete

INTERNAL URETHROTOMY FROM BEFORE BACKWARD.—The best ins
ment for performing this operation is Maisonneuve's urethrot
(Fig. 87), or one of its modifications, as described by Teevan.

FIG. 87.

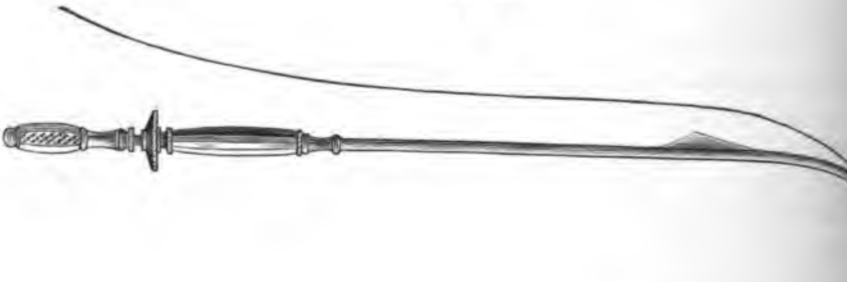


Maisonneuve's urethrotome.

Maisonneuve urethrotome is provided with screw-tipped filiform
gies, which are first passed through the stricture into the blad
The tip is then screwed to the urethrotome, and the latter is in
duced, accurately guided by the filiform.

In Teevan's urethrotome (Fig. 88) the groove of the staff te
nates two inches from the end. By means of a stylet a triang

FIG. 88.



Teevan's urethrotome.

blade contained in a double sheath is made to slide along this gr
and to expose its cutting edge when the stricture is reached.
screw on the end of the staff is provided for the attachment of
filiform bougie. By the withdrawal of the stylet the instrume
converted into a catheter, thus allowing the surgeon to assure him
that the instrument has certainly passed into the bladder by the p
afforded by escape of urine. Both these instruments divide the s
ture on the urethral floor to a sufficient extent to allow of the pas

of a dilating urethrotome, by means of which an incision in the roof of the urethra can be made, restoring it to its normal calibre.

Cutting the stricture from before backward is thus performed. A fine, flexible, guiding bougie is passed into the bladder. The screw end of this is secured to the urethrotome, and the tip of the latter is passed through the stricture into the bladder and held in position by an assistant. The operator with his left hand draws the penis forward and with his right hand pushes the sheathed knife down the urethra until the obstruction is reached. The cutting edge of the knife is then exposed and all the resisting tissue in front of it is divided. The knife is then drawn into its sheath, and the latter is pushed along the urethra, gliding in readily if the division has been complete. If the sheathed knife meets with an obstruction when it is pushed forward, the incision may have to be repeated; but this is undesirable. If the stricture is thoroughly divided, the instrument is withdrawn immediately and a full-sized silver catheter is passed, the bladder emptied, and the catheter withdrawn. If the stricture is not fully divided,—and this is usually the case when the Maisonneuve or Teevan instrument is used,—the foregoing operation may be regarded as a preliminary to division from behind forward by a dilating urethrotome, and the introduction of the latter instrument (rendered possible by the previous incision) should be the next procedure, the incision in this case being made on the roof of the urethra. After the operation the patient is put to bed and placed on quinine and urinary antiseptics,—*i.e.*, salol five grains, boric acid ten grains, each three or four times a day.

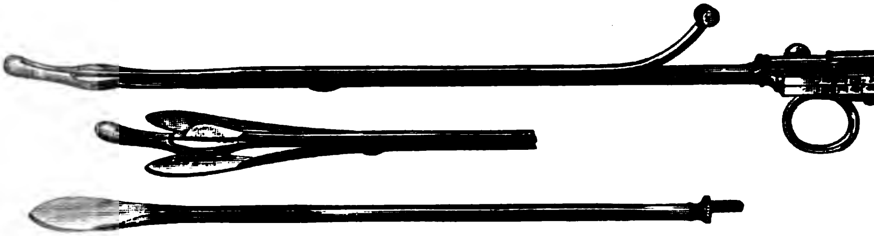
If no rigors have occurred within forty-eight hours after the operation, a sound equal in size to the catheter is passed through the divided stricture. The patient is then allowed to get up, the sounds being subsequently passed every three or four days, then every week, etc.

INTERNAL URETHROTOMY FROM BEHIND FORWARD.—Among the many instruments devised for this operation, Civiale's urethrotome, or some modification of it, is probably the best. It consists of a slender straight shaft with a small bulbous end. The knife is concealed in the bulb, and by a simple contrivance in the handle it can be projected one, two, three, or four degrees, according to the depth of the incision required. The method of procedure is as follows. The stricture having been dilated to No. 10 or No. 12 French, the bulbous end of Civiale's urethrotome is passed fully one-half or three-quarters of an inch beyond the stricture, the knife is exposed on the roof of the urethra, is held firmly in place in its relation to the instru-

ment, and is withdrawn until all resistance is overcome. The bl
is then sheathed and the instrument withdrawn. A full-sized sou
is then passed into the bladder. If this meets with any obstructi
the situation is noted, the urethrotome is reintroduced, and the
structing tissue is divided.

The urethrotome invented by Otis is very useful in the treatm
of strictures of large calibre. It is constructed on the principle
the parallel ruler, and when closed measures 18 (French).
bars are separated by means of a screw apparatus at the han
the amount of separation being registered on a dial. A sheat
knife runs in a groove cut in the upper bar of the instrument.
urethrotome is introduced beyond the stricture and then dilated
to or a millimetre or two above the normal calibre, in order to m
the fibrous bands completely salient; then the blade is drawn thro
the entire area of narrowing.

FIG. 89.



Gerster's urethrotome.

Gerster's urethrotome (Fig. 89) is constructed on the same gene
principles as that of Otis, but possesses the advantages of more
curately locating the seat of narrowing and of being readily tal
apart, so that it can be thoroughly cleansed after use.

Gross's urethrotome serves as an exploring and a cutting inst
ment at the same time. When the shoulder of the bulb is brou
up to the posterior face of the stricture the concealed blade can
protruded and the stricture divided as the instrument is withdrawn

The choice of the urethrotome is of small moment in the inter
cutting of stricture. The essential feature of the operation is t
a linear incision should be made in the roof of the urethra (exc
at or near the meatus or in the membranous urethra) through eve
portion of stricture tissue, the cut extending from the normal pa
behind to the normal parts in front of the stricture and enabling
surgeon to pass at once an instrument two sizes larger than
normal calibre of the urethra.

If the narrowing is of very small calibre, a preliminary urethr omy from before backward may be done with Maisonneuve's instrument, after which a dilating urethrotome completes the operation from behind forward. Careful observance of the principles of urethral and urinary antisepsis as already described (page 230) reduces to its minimum the risk always attendant on internal urethrotomy.

In children internal urethrotomy has the same applications as in the adult, but the urethrotome must be modified in calibre and length to suit the age of the individual patient.

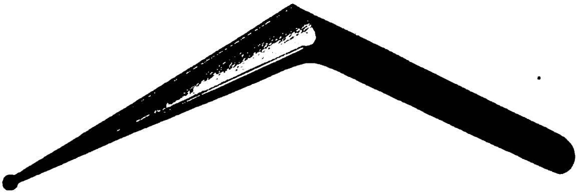
External Perineal Urethrotomy.—By this operation the urethra is opened by an incision carried inward from the skin surface of the perineum. In accordance with the calibre of the stricture, certain modifications will be necessary in the performance of this operation.

Thus, if the stricture is permeable, 1, *external perineal urethrotomy with a guide*, or *Syme's operation*, is indicated, a grooved staff being carried through the narrowing and the incision being made on this.

If the stricture is impermeable, 2, *external perineal urethrotomy without a guide, or "perineal section,"* is indicated, a staff being carried down to the anterior face of the stricture and the urethra being opened at this point; subsequently, aided by sight, the stricture is divided from before backward.

1. External Perineal Urethrotomy with a Guide, or Syme's Operation.—The instruments required for this operation are a grooved staff, a scalpel, a probe, a broad grooved director, or a Teale's probe gorget (Fig. 90), and a soft rubber or English catheter of large calibre. The grooved staff (Fig. 91) has a narrowed terminal part which is passed through the stricture. Where this narrow portion joins the shaft there is a shoulder, which rests against the anterior face of the stricture when the instrument is in position. The patient having been etherized, the staff is introduced, and the patient is placed in the lithotomy position.

Fig. 90.



Teale's probe-ended gorget.

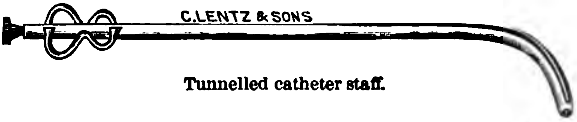
The use of the Syme staff is possible only when the stricture will admit at least a No. 6 F. instrument; when it is so tight that nothing larger than a filiform bougie can be passed, a grooved staff similar to Syme's, but with a quarter of an inch of its extremi bridged over so as to convert the groove into a canal, a "tunnelled cat eter staff" (Fig. 92), is used, and is threaded over a filiform bougie.

In passing the filiform the urethra is first overdistended wi carbolized oil, then the filiform is gently introduced. If it ente a false passage it is held in place, while another bougie is passed its side. The second is allowed to remain where it is arrested, ar other bougies are passed, some straight-tipped, others angled or cor screwed, till finally one goes through the stricture into the bladd The other guides, often five or six in number, are then withdraw The tunnelled staff is threaded over the free end of the filiform, a is gently pushed towards the bladder, the guide being held by t left hand. It is best to release this guide, if the strain and frictio become great, and allow it to be pushed onward with the staff. I end will, of course, disappear within the urethra, but can usually found again within an inch of the meatus by pressing the penis bac ward after the metallic instrument is in the bladder; if it cannot found thus, it will certainly reappear when the staff is withdrawn.

Fig. 91.

Syme's grooved staff.

Fig. 92.



Tunnelled catheter staff.

In whatever way the staff has been passed, the assistant who hol it is directed to make its convexity bulge in the perineum. The le forefinger of the operator is inserted into the rectum, and an incisio is made one inch in front of the anus and exactly in the median li of the perineum. This incision is deepened till the knife-point ente the groove of the narrow part of the staff, usually behind the strictu The latter is then divided by cutting from behind forward until t projecting shoulder of the staff is freed and passes onward towar the bladder without difficulty. A director or Teale's probe gorget now introduced along the groove of the staff into the bladder, and t staff is withdrawn. Finally, a rubber catheter, No. 24 to No. 28

is passed from the meatus into the bladder, guided by the director or gorget, and aided in its course by manipulation through the wound. This catheter is retained for three days, and is then withdrawn. Should urethral or vesical irritability prevent the retention of a catheter, a tube may be passed into the bladder through the perineal wound and retained in position by silk threads secured to a T bandage. In from five to seven days a full-sized sound is passed through the penile urethra into the bladder, and this is repeated every third day for a month, after which the intervals between instrumentation may be made progressively longer.

If the filiform passes but the tip of the tunnelled staff cannot be forced through the stricture, the latter is held in contact with the anterior surface of the narrowing by an assistant, and is exposed by a free incision in the median line of the perineum, splitting the urethra in front of the stricture; a loop of silk is then passed through each edge of the divided urethra close to the face of the narrowing, thus enabling the canal to be held open. The staff is withdrawn a little in order to bring the black filiform into view, and then the stricture is divided from before backward, together with half an inch of the uncontracted canal behind it, by means of a probe-tipped bistoury. The last step consists in passing the staff, guided by the filiform, into the bladder. The subsequent treatment is the same as in Syme's operation.

The general indication for external urethrotomy is the existence in the deep urethra—*i.e.*, posterior to the bulbo-membranous juncture—of a stricture not amenable to dilatation. Under this head will come a great variety of strictures, which may be classified as follows.

1. Stricture which is resilient or so densely fibrous that it will not yield to either continuous or intermittent dilatation. Traumatic stricture is typical of this class of cases. 2. Stricture behind which extravasation of urine has occurred. 3. Stricture complicated with perineal abscess, the latter being laid open at the same time that the stricture is divided. 4. Stricture complicated with fistulæ which do not close after full dilatation. 5. Stricture complicated with a cystitis so intense that continuous drainage of the bladder is indicated. 6. Stricture associated with enlargement of the prostate and refusing to yield to dilatation. 7. Stricture complicated with retention of urine or with the "incontinence of retention." The high degree of atony of the bladder which ordinarily exists in these cases renders perineal drainage exceptionally desirable. 8. Stricture in which urethral fever follows instrumentation, or in which renal congestion or nephritis is known to exist.

The Prognosis of Stricture after External Perineal Urethrotomy.– The thorough division of stricture by external urethrotomy occasionally results in cure without further treatment. This, accordin to Guyon, is because the elastic fibres of the urethra run circularly when cut they retract, and restoration of the urethral lumen is accomplished by means of a wide scar, which usually does not contrac sufficiently to produce stricture again.

It is possible that recent strictures unattended by submucou fibroid infiltration can be cured either by gradual dilatation or b section. When there is distinct fibroid periurethral infiltration, wit decided alteration of the mucous membrane, section, followed by prolonged course of gradual dilatation, will usually accomplish practical but not a truly radical cure. In densely fibrous inodula stricture a radical cure can be attempted only by means of excisio and even then will probably not be attained: hence, though a stricture be cut, either internally or externally, the intermittent use of th sound for a long period should be advised.

COMBINED INTERNAL AND EXTERNAL URETHROTOMY.—This operation described by Reginald Harrison, its chief advocate, as follows: Th stricture is divided by means of a urethrotome. The patient is the placed in the lithotomy position, a grooved staff is introduced, and, wit a long, straight knife entered one inch in front of the anus, the membranous urethra is punctured, the back of the knife being towards th rectum. The incision is slightly enlarged forward, to permit the introduction of the index finger. If the staff is not fully exposed, somewhat dull though pointed knife is introduced along the finge and the tissue still remaining between the tip of the finger and th groove is cleared away. If a sharp knife is used, there is danger o making the incision unnecessarily large or of cutting the finger. Th incision is planned first to fit the finger and afterwards the drainag tube. When the groove of the staff is felt, a probe-tipped gorget slid along it, the staff is removed, and a drainage-tube is passed alo the concavity of the gorget into the bladder. This tube drains th bladder directly, giving the urethra physiological rest. It is retaine seven to ten days; after the second day it is taken out and cleans daily, and the bladder is irrigated twice daily with a 1 to 10,000 or to 5000 sublimate solution.

This operation possesses the advantage of preventing the fresh cut stricture from being irritated by the urine. Since contact wi urine is an essential factor in the production of organic strictur such a diversion of the stream during attempts at radical cure worthy of consideration whenever resilient, inodular, or traumat anterior strictures are cut, or whenever the coarctation is complicated by fistulæ; physiological rest is thus obtained for the whole region, and the inflammatory products in the wall of the urethra are allowed to undergo fatty degeneration and absorption. In deep strictures the combined operation is less likely to be useful, as external urethrotomy meets the same indications, the incision being carried behind the strictured region into healthy tissue and the retained catheter serving to divert the urine.

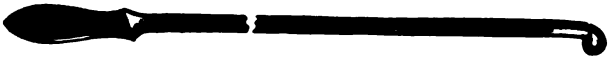
Harrison, however, particularly recommends his operation in cicatricial, contractile, and relapsing strictures seated in the deeper part of the urethra, claiming for it the following advantages: 1. It is applicable to the worst forms of urethral strictures. 2. It guards against rigors, fever, and the complications which tend to rise from these. 3. It tends to improve permanently the condition of the stricture.

Experience has shown that if the tissues can be freed from every source of irritation and can be given physiological rest for a long period, hardened lymph will disappear and the urethral walls again will become soft and yielding. Drainage by perineal opening is the only way in which complete rest can be given to the strictured region.

Perineal Section.—This operation is reserved for strictures through which the smallest instrument cannot be made to pass. Such strictures, whether gonorrhœal or traumatic, are usually deeply seated, and are approached through the perineum.

A special hooked staff (Fig. 93) is required, in addition to a probe-tipped gorget, scalpel, forceps, needles, etc. The patient is placed in the lithotomy position, and the staff is introduced with the groove towards the floor of the urethra, its hooked extremity being brought gently into contact with the stricture. No force is permissible, since the urethra in these cases is readily torn. While an assistant holds the staff in position, an incision is made in the perineum, and the urethra is exposed, and is opened in the groove of the staff, not upon its point, thus making the incision at least a quarter of an inch in front of the stricture, since the groove is not continued to the hook-shaped extremity of the staff. Through the edges of the urethral incision are passed by means of curved needles stout silk threads, one on each side, forming loops, by drawing on which

Fig. 93.



Wheelhouse's staff.

the urethral walls are retracted. The staff is gently withdrawn unt the button point appears in the wound. It is then turned aroun so that the groove faces the roof, and the button is hooked i the upper angle of the open urethra. The urethra is now stretche open at three points just in front of the stricture. The button on th staff, however, is often in the way, and, if so, this instrument shoul be withdrawn. With the anterior surface of the stricture thus ex posed, the narrow opening through it is often seen, and a prob pointed director is passed without difficulty. Even if warty growt or granulations conceal the position of the narrowed channel, caref probing with the director usually results in the ready passage of th latter into the bladder; this is shown by the freedom with which th tip of the director can be moved about. The groove of the director then turned downward, and along it the whole length of the strictu is carefully and fully divided, this part of the operation being complet by running a straight probe-pointed bistoury along the groove insure the cutting of every band. Teale's gorget is now passed alon the groove of the director into the bladder, and the director is wit drawn. The object of the gorget is to facilitate the introduction catheters into the bladder, at times a most difficult procedure af perineal section. A full-sized soft rubber catheter is passed from th meatus into the bladder, the gorget is withdrawn, and the catheter fastened in the urethra. After three or four days the catheter removed. Sounds are then passed daily or every second day or eve third day, according to circumstances, until the wound in the perineu is healed, and after that from time to time to prevent recontraction.

If the probe-pointed director does not find the opening throu the stricture, the operation must be continued by dissection until th urethra is fairly opened. If the bladder contains urine, pressure the hypogastrium, or bimanual pressure, one hand being placed the abdomen and a finger of the other in the rectum, will often cau the expulsion of some urine, and thus show the opening through th stricture. The use of very hot water will sometimes be of service emphasizing the difference in color between ths surrounding par and the urethra, the latter being much paler.

The operation requires a good light, and often much patience.

Indications for External Perineal Urethrotomy without a Guide.— Perineal section in some form is indicated in all cases of impassa stricture. If there are no other complications, Wheelhouse's meth is the best to employ. But in cases in which a portion of the ureth has been practically destroyed, in which urinary extravasation h occurred, and the perineum is riddled with sinuses, and in those great urgency from retention, when no aspirating apparatus is at hand, Cock's operation is indicated. The operation is a difficult one, is sometimes disappointing in the best hands, and should be abandoned if the urethra is not opened at the first or the second trial.

Retrograde Catheterization.—When all guides fail, and when after perineal section the proximal end of the urethra cannot be found, as in cases of traumatic stricture with practical obliteration of the canal, a suprapubic cystotomy and retrograde catheterization are indicated. The slight additional risk is far outweighed by the advantages to the patient of having even an imperfect restoration of the urethral canal.

In performing retrograde catheterization the suprapubic opening into the bladder is made sufficiently large to admit the finger; guided by the latter, which can readily feel the vesical orifice of the urethra, a steel sound or a silver catheter is introduced from behind forward till its tip becomes apparent through the perineal opening. When the belly is prominent it may be difficult to pass an ordinary sound, by way of the small vesical opening, into and through the prostatic and membranous portions of the urethra. To obviate this difficulty Guyon has suggested an instrument with a longer or more complete curve; in the absence of this, an English gum catheter, provided with a stylet and with the required curve given it and fixed for the time by immersing the instrument in cold water, may be employed. As soon as the tip is freely exposed through the perineal wound, a soft catheter, the end of which has been cut off, is slipped over it; on withdrawing the sound this catheter is carried from the perineum through the suprapubic opening. A sound having been passed from the meatus to the perineal wound, the other end of the soft catheter is forcibly pushed over its tip and is drawn forward till it projects from the meatus. The tube is left in place for from five to seven days.

Drainage after External Urethrotomy and Perineal Section.—Drainage should be provided for by a large English or soft rubber catheter (No. 24 to No. 28 F.), passed through the urethra *till its eye is just within the bladder*, and retained in position from three to five days. If the end of the catheter is not allowed to project far into the bladder, and if it is kept clean by regular antiseptic injections repeated twice daily, it is most efficient as a means of preventing urethral fever. After removal of the catheter first introduced, regular dilatation at short intervals is indicated.

The traumatic urethritis which the retained catheter or the frequent use of the instrument is said to occasion will hardly ever occur when antiseptic irrigations are properly used, and when the urine is sterilized by the administration of drugs by the mouth.

These irrigations must cleanse both the bladder and the ureth The tube from an irrigating bag containing the antiseptic and hang two feet above the level of the bladder is attached to the catheter, a the latter is slowly withdrawn till the fluid escapes through the mea or through the perineal wound. The urethral mucous membran flushed with from a pint to a quart of the antiseptic, after which catheter is passed in till its eye lies just within the bladder, and secured in place till the next washing.

Miscellaneous Methods.—EXCISION.—A number of success cases of excision, usually for traumatic stricture, have been repor by Heusner, Koenig, Poncet, and others.

Poncet states that the indications for urethrectomy are found in existence of marked fibrous induration encircling the perineal ureth and in a history of previous unsuccessful operations.

Rollet, Southam, Sapregko, and others report excellent res from excision of dense fibrous strictures, with subsequent suturing the urethra over a catheter.

Excision with Transplantation of Mucous Membrane.—Wölfler reported three cases in which he employed Thiersch's method transplanting epiderm for the radical cure of impermeable strictu The strictured portion of the urethra was first excised, and aft wards the granulating surface was entirely covered with muc membrane dissected from a prolapsed uterus. This mucous me brane was kept in place by a packing of iodoform gauze lubrica on the inner side with vaseline. The first patient one year aft and with no intermediate treatment, urinated a thick stream. T second did as well, but the observation had not lasted so long. T third died six months after the operation, from double nephritis, a the autopsy showed a continuous mucous membrane. The boun ries between the old and the new mucous membrane could not clearly demonstrated.

ELECTROLYSIS.—The evidence adduced in favor of this method insufficient to warrant its general adoption, and does not even just a belief in its usefulness in the average case.

DIVULSION.—This method is clumsy, uncertain, and dangero Under this general heading may be included forced catheterizati immediate progressive dilatation, tunnellization, progressive divulsi and the modifications of this latter method. All involve ruptu of the mucous or submucous tissue to an indeterminable ext and to an uncertain point, and have all the disadvantages of inter urethrotomy, with the superadded risk of a lacerated and contus wound as compared with an incised wound.

SUMMARY OF TREATMENT.

1. GRADUAL DILATATION is indicated as the treatment of choice in all recent, soft, or dilatable strictures found in any part of the urethra, without regard to the calibre of such strictures.

2. CONTINUOUS DILATATION is indicated in uncomplicated strictures which are so tight that no instrument larger than a filiform can be made to pass. This continuous dilatation is practised till a small metal instrument can be introduced,—No. 12 to No. 16 F. Then the normal calibre of the urethra is restored by gradual dilatation or by cutting, in accordance with the nature and the clinical behavior of the stricture.

3. INTERNAL URETHROTOMY is indicated in all fibrous, irritable, and resilient strictures anterior to the bulbo-membranous juncture. Narrowings at or near the meatus should be treated by the knife whenever it is apparent that they are responsible for definite symptoms. The division is here made on the *floor* of the urethra. All other anterior strictures are divided along the *roof*.

4. EXTERNAL PERINEAL URETHROTOMY is indicated in all fibrous, resilient, or irritable strictures situated behind the bulbo-membranous juncture.

5. COMBINED INTERNAL AND EXTERNAL URETHROTOMY is indicated in the treatment of *anterior* strictures which are unusually dense or nodular and which are complicated by fistulæ.

6. PERINEAL SECTION, or external perineal urethrotomy without a guide, is indicated in the treatment of impassable stricture of the deep urethra. When the proximal urethral end cannot be found, *suprapubic cystotomy* and *retrograde catheterization* are justifiable.

7. EXCISION is indicated in cases of impermeable stricture, nodular or fibroid, where there has been complete destruction of mucous membrane. When so much tissue is removed that it is impossible to bring the divided urethral ends in apposition, *transplantation* of mucous membrane is indicated.

Formulating the operative indications in accordance with the clinical features of the stricture, the following summary of treatment is given.

1. Narrowings at or near the meatus, if treated at all, are always cut.

2. Strictures of large calibre (greater than 15 F.) are treated by gradual dilatation. Cutting is almost never required when such a stricture is in the deep urethra; it is sometimes necessary when the stricture is anterior to the bulbo-membranous juncture.

3. Strictures of small calibre are treated by gradual dilatation

if possible; when in the deep urethra they often require ext urethrotomy; when anterior to the bulbo-membranous juncture usually require internal urethrotomy.

4. Impermeable strictures are treated by perineal section, follo at times by excision and mucous membrane grafting.

5. Soft, recent, uncomplicated strictures are always dilated.

6. Fibrous, nodular, irritable strictures complicated by uri fever, fistula, etc., are always cut.

STRICTURE OF THE FEMALE URETHRA.

Stricture of the female urethra is comparatively rare. In caus symptoms it corresponds with the like condition of the male ure It may be congenital or acquired, and the acquired stricture ma spasmodic, inflammatory, or organic. The congenital stricture i in the case of the male, usually placed at or near the urinary me

Spasmodic stricture, that due to muscular spasm, is more freq than in the male. This is doubtless owing to the greater reflex ceptibility of women. Familiar examples are afforded by reter of urine due to fright, exhaustion, exposure, urethritis, caruncles,

Inflammatory stricture—*i.e.*, encroachment on the urethral ca by acute inflammatory swelling—probably never becomes suffici marked to produce retention, this when it occurs being due to sp reflexly excited from the hyperæmic and hyperæsthetic areas.

Organic stricture is due to trauma, commonly inflicted du childbirth, or to inflammation, usually gonorrhœal in nature, b sometimes occasioned by a urethral calculus, or by the viru chancre or chancroid, or by irritating applications. The ure narrowing is due to the contraction of the fibrous tissue which been deposited in the walls of the canal as an inflammatory infil and which has subsequently become organized. Hermann states in old women there is found stricture due to general fibroid thicke of the urethra, occurring without any history of gonorrhœa or c discernible cause. The seats of narrowing are oftenest at or nea meatus and near the neck of the bladder. The stricture is usu single, and frequently occasions so little inconvenience that its pres is not suspected by the patient.

Skene states that organic stricture sometimes occurs at the j ture of the urethra with the bladder, and that even though it b large calibre it occasions symptoms out of all proportion to the am of narrowing it produces; this is probably because there is infi tion of the vesical sphincter and interference with its function. cult urination and retention are the most characteristic sympt the stricture being of such a large calibre that it may escape detection by the bulbous bougie.

Symptoms.—The symptoms of stricture in women are frequent urination, dribbling after the act, the passage of an irregular stream, and often urethral discharge.

At times the only symptom is an occasional attack of retention of urine occasioned by slight causes, such as exposure or fatigue, and usually ascribed to muscular spasm. Though the spasmodic element is in these cases always the exciting cause of the retention, the predisposing cause will occasionally be found to be a urethral stricture of large calibre.

Difficult urination and sometimes retention particularly characterize stricture at the juncture of the urethra and the bladder.

Diagnosis.—The diagnosis is made by careful examination of the floor of the urethra by means of a finger introduced into the vagina and by the passage of bulbous bougies. By the vaginal touch cicatricial induration of any part of the urethra, if marked, can be found. This is the most reliable method of detecting the stricture of the neck of the bladder, described by Skene, since the narrowing may be so slight that a comparatively large instrument may pass through readily.

In passing the bulbous bougie it must be borne in mind that the urethra in women has two points of physiological narrowing,—*i.e.*, the meatus and the neck of the bladder; the canal between these points admits of wide dilatation. If a very large bulbous bougie is introduced, the resistance offered to the inward or outward passage of the instrument by the seats of normal narrowing might readily be mistaken for that due to organic stricture.

Prognosis.—The prognosis of stricture of the urethra in women is much less serious than is the case with men. The narrowing rarely reaches such a degree that the function of micturition is greatly interfered with, and hence the train of vesical, renal, and general vascular changes which ultimately result fatally is rarely inaugurated. In exceptional cases when the urethral calibre is markedly encroached on, if the condition is unrelieved, the prognosis is the same as for men.

Treatment.—Congenital or inflammatory narrowings of the meatus should be cut freely, the normal calibre being maintained by the use of a meatus bougie. The directions given for the performance of meatotomy in the male obtain in these cases. Soft, recent, dilatable strictures are gradually cured by short straight steel sounds. Dense, traumatic, nodular, irritable, or resilient strictures are treated by internal urethrotomy. When the urethra is totally obliterated at one point the propriety of excision and of mucous membrane transplantation may be considered.

CHAPTER VII.

URETHRAL FEVER.—FISTULA.—POUCHES.—VEGETATIONS.—DISEASES OF C PER'S GLANDS.—URETHROSCOPY.—CARE OF URETHRAL INSTRUMENTS.

URETHRAL FEVER, called also urinary fever and catheter fever, is most serious sequel of mechanical interference with the urethra, is due to absorption of bacteria or their poisonous products throu hyperæmic or abraded mucous surface.

Since the passage of an instrument into the urethra has b shown to produce a sudden, sometimes very pronounced fall of bl pressure, it is not difficult to account for the syncope so freque observed as a result of even the most gentle introduction of the so As a direct or remote result of this primary reflex influence on circulation, when the kidneys are already diseased, it is conceiv that their secretory function may be abolished, and that death result from the uræmia incident to anuria. Such cases—*i.e.*, th characterized by syncope, collapse, or anuria, presenting all the sy toms of shock and exceptionally terminating fatally in a very hours—are not properly classed under urethral fever, and sh receive the immediate stimulating treatment appropriate to sync or shock and afterwards that called for in uræmia.

There is, however, evidence that the reflex element, aside f primary syncope, plays a minor *rôle* in the development of the p nomena just described. Although certain forms of urinary fever apparently too rapid in their course to be ascribed to septic in tion, Albarran reports a case of internal urethrotomy in which bacterium coli commune was found in the blood of the patient, died twelve hours after operation. This same micro-organism was covered in the urethral pus. From this and from many similar ca it would seem clear that even though the classical symptoms of se absorption are absent,—*i.e.*, chill, fever, and sweat,—and though case progresses to a fatal issue in a few hours, this rapid and irreg course does not necessarily imply a reflex non-septic inhibition of renal function. When the kidneys are already crippled, it is poss that even slight interference with the urethra may arrest their act and as a result death may occur independently of sepsis.

Etiology.—Retention of urine, with the consequent effects on bladder walls and the kidneys,—*i.e.*, chronic cystitis, pyelitis, and nephritis,—acts as a strong predisposing factor in the development of urinary fever. As an exciting cause, contact of infected urine or of purulent discharges with fissure or abrasion of the mucous membrane of the urethra is sufficient. Urethral fever by no means follows as a rule in consequence of such contact. It is well known that forcible, clumsy, unsuccessful catheterization, attended by profuse bleeding and rupture of the urethra, may be followed by no constitutional symptoms, while the most skilful and gentle introduction of an instrument may cause a malignant form of urinary fever.

Lesions situated behind stricture and seats of obstruction, and particularly lesions of the deep urethra, are more liable to be followed by urinary fever than are wounds so placed that the septic fluids are not driven into them.

It has been noted frequently that in cases where urinary fever occurred each time a stricture was sounded, instruments could be passed with impunity on complete cure of the narrowing. In some cases no fever develops till after the urine has come in contact with the raw surface: thus it is not uncommon to have a post-urethrotomy urinary fever delayed till from the third to the fifth day, when the permanent catheter is removed, and the urine is allowed to flow over the raw surfaces. After perineal urethrotomy and cystotomy, urinary fever is extremely rare.

The constitutional symptoms incident to rapid extravasation of urine are those characteristic of diffuse cellulitis, and are not properly classed with urinary fever.

Symptoms.—The particular form in which urinary fever may manifest itself is quite independent of the severity of the exciting lesion, since in at least one reported case, in which death occurred a few hours after the passage of a catheter, no breach was found in the continuity of the urethral mucous membrane. The character of the fever is probably dependent on the virulence of the germs and on the tissue resistance of the individual.

Guyon classifies urinary fever under the general headings of acute and chronic.

Acute urinary fever may take one of the two following forms: 1, single paroxysm; 2, recurrent paroxysms.

ACUTE URINARY FEVER.—*Single Paroxysm.*—This is characterized by chill, fever, and sweat. The chill may come on a few minutes after catheterization; usually it follows the first act of micturition subsequent to urethral interference. The chill is pronounced, the fever high, 103° to 105° F., the sweat copious.

There is a single paroxysm, which subsides in twenty-four h
at its height there may be pain in the head and back, deli
dyspnœa, nausea, and vomiting. Usually the pulse is full and st
the mind is clear, and the patient feels comparatively well.

This form of urinary fever is the most common, and when
frankly expressed is not greatly to be dreaded. If the chill is se
the heart action modified out of proportion to the amount of
and the patient delirious and markedly dyspnœic, the chance
that there will be renewed paroxysms.

Exceptionally the chill is unduly severe and prolonged, la
possibly for several hours; the patient becomes collapsed, vo
purges, ceases to secrete urine, and dies in a few hours, or in
or two days, of shock, of uræmia, or of virulent septic poisonin

2. The form with *recurrent paroxysms*, termed by Thompson
recurring urinary fever, is characterized by irregular and appa
causeless elevations in temperature, preceded by rigors or
which are not so well marked as in the first attack, and are foll
by sweats. The temperature in the interim does not reach no
the heart action continues unduly rapid. These paroxysms may
several times a day, or the intervals may be of one to several
duration. Oppression in breathing and congestion of the lung
often noticed. In favorable cases these attacks cease in a few day
week, and the patient shortly regains strength, though not so rapi
after the single paroxysm. When there is a focus of suppuration,
cases of prostatic abscess or limited urinary extravasation, septic
or pyæmia may develop, with characteristic symptoms, and, if th
fecting focus is not found and drained, usually with a fatal termin

CHRONIC URINARY FEVER.—This may directly follow either
preceding forms, or may develop insidiously, at times without ele
of temperature. Long-standing retention, and the consequent ch
in the bladder and kidneys, are the common predisposing fa
The exciting factor is infection incident to catheterization.

Symptoms.—The symptoms of this form of urinary fever are
or uræmic. Hectic—*i.e.*, irregular paroxysms of chills, fever
sweat, with progressive loss of strength—may be combined wit
brown tongue, vomiting, diarrhœa, headache, and stupor. This
dition may last for weeks without instrumentation, but is pro
terminate fatally on the slightest mechanical interference wit
bladder or the urethra.

Prognosis.—Urethral fever, when it appears as a single paro
none of the stages of which are markedly severe or prolonged, i
especially serious. A heavy, prolonged chill, especially if it is

ciated with a rapid pulse-rate out of proportion to the temperature, and with suppression of urine, always suggests a malignant and at times a rapidly fatal form of infection.

In recurrent paroxysms, if the kidneys are healthy and the patient is young, the prognosis is fairly good.

In chronic urinary fever the prognosis must be guarded. Old prostatics who have suffered long before being relieved usually die when this form of urinary fever develops; indeed, it is commonly a sign of septic infection of the kidneys. In younger men with retention from stricture the prognosis is somewhat more favorable.

Treatment.—Rigid antisepsis, both of instruments and of the urethra and the bladder, is the most potent means of preventing urinary fever. Before operating on the urethra a preliminary bacteriological examination of the urine is advisable. If virulent colonies of the colon group are found, it is well to postpone operation till these have disappeared as a result of internal and local antiseptic treatment, or if surgical interference is urgently demanded this should be followed by perineal drainage.

Acute urinary fever, characterized by a single paroxysm or by recurring paroxysms, provided the urine is abundant and normal and the circulation is not materially disturbed, requires only rest in bed, the administration of urinary antiseptics, a bland liquid diet, preferably milk, and a mild saline, Hunyádi or magnesium sulphate, in sufficient doses to cause three loose passages a day. When the constitutional symptoms are well marked, the pulse becoming progressively more rapid and feeble, stimulants and tonics are indicated, much the same treatment being pursued as for septicæmia. Should the urine become loaded with albumen or contain blood, or should the kidneys cease to secrete, dry cups over the loins, a half-dozen to each side, followed by a digitalis poultice, full doses of tincture of digitalis, a teaspoonful thrice daily (Otis), and on the supervention of uræmic symptoms the hot vapor bath, repeated according to the indications, are the measures which promise best results.

When in spite of careful local and general treatment symptoms of septic absorption are steadily progressive, perineal drainage should be established, supplemented by copious urethral and vesical irrigations. This operation—indeed, any interference with the urethra—is, in the case of those who have long suffered from retention of urine to which has been superadded urinary fever, so often followed by an aggravation of constitutional symptoms that there is a natural reluctance on the part of surgeons to operate. Under the circumstances, however, such interference practically holds out the only hope. If the organism has already received a fatal dose of the ger or their products, or if the kidneys are hopelessly disorganized, operation can at the worst merely hasten the inevitable fatal t mination. If the infection is progressive because of constant fre absorption from the urethra, perineal drainage may be as servicea as is opening an abscess in a case of ordinary suppuration.

FISTULA OF THE URETHRA.

Fistula of the urethra is an abnormal opening through which urine escapes from this canal, either into the rectum or external Very exceptionally these fistulæ are congenital, and are due to establishment of the function of the kidney before the urethral ca is fully formed. The bladder becomes overdistended, and the ureth not being pervious, ruptures at a point behind the obstruction, th relieving tension and allowing the urine to escape.

The usual cause of urethral fistula is slow leakage of urine incid to ulceration behind a stricture, though suppurative folliculitis a periurethral abscess occurring in the course of acute or chronic gon rhœa, the lodgement of a stone or of a foreign body, or rupture wound of the urethra may result in fistula formation.

In accordance with the position of the opening and course of tract the fistula is named urethro-rectal, urethro-perineo-scrotal, urethro-penile.

Urethro-rectal fistulæ, in the non-congenital varieties, forme were usually due to injury inflicted during the perineal operation stone, the rectum being accidentally wounded.

The common cause at the present time is the slow backward tension of prostatic abscess, the ulceration ultimately reaching a destroying the rectal wall, and forming a small opening, except cases of acute inflammation. Tubercular or malignant infiltrati whether primary in the urethra or in the rectum, often causes tissues lying between to break down.

Finally, a foreign body or calculus long retained in the prost urethra may produce urethro-rectal fistula. In such cases urethral opening is usually small, and is generally in the prost portion of the canal, at the side of the verumontanum, the cou of the fistula being obliquely downward and backward: hence th is less chance of fæces passing into the urethra than of the ur flowing into the rectum. In addition to the rectal opening ther often a tract opening into the perineum. Other tracts may fo passing back to the perineum and to the ischio-rectal region, or throu the great sacro-sciatic foramen opening near the hip-joint, or upw on the belly-wall. The main tract, starting from a prostatic or periprostatic abscess-cavity, has often many diverticula, forming blind suppurating sinuses.

The fistulous tract forms a dense, cord-like band, easily felt on rectal examination, when there is not much infiltration of surrounding tissues. The opening into the rectum is placed within the sphincter, and may be so small and so well covered by rectal folds that the finding of it will be difficult; in malignant and tubercular cases it is marked by a button of exuberant granulations. Following large, rapidly extending abscess of the prostate there is decided loss of substance, the opening then being of considerable size. The contact of the urine often produces an inflammatory condition not only of the rectal mucous membrane but also of the skin surrounding the anus.

Symptoms.—Pathognomonic symptoms of urethro-rectal fistula are the passage of urine by the rectum and the escape of gas and exceptionally of fæces through the urethra.

The quantity of urine passing into the rectum varies in accordance with the size of the fistula. When the urethra is not obstructed, but a few drops escape in this direction. These usually appear externally during or immediately after urination, though sometimes the urine is retained and is discharged by the motions of defecation, exactly as would be a liquid stool. Gas and fæces may escape from the urethra either during or after defecation.

On rectal examination the nodular induration characteristic ot a fistula is easily detected. By means of a speculum the opening of this tract can be found and a probe can be passed through it, encountering the end of a sound passed through the urethra and into the bladder. The urethral orifice can sometimes be detected by urethroscopic examination, and positive diagnosis may be made by forcing a colored liquid, such as one-tenth per cent. methyl-blue solution into the urethra, and noting whether or not it can be seen in the rectum. Or equally decisive is the injection of hydrogen peroxide into the rectal opening of the fistula, the bubbles due to oxidation then appearing in the urine.

Diagnosis.—The differential diagnosis of urethro-rectal from vesico-rectal fistula is made by cystoscopic examination and by injection of colored fluids in moderate quantity directly into the bladder with the patient in the dorsal decubitus. If the fistulous opening be in the urethra, this solution will not appear in the rectum till the patient urinates. In urethro-rectal fistula urine usually escapes only during the act of micturition, and the inflammation of both the rectum and the bladder is much less marked than when the opening is directly into the latter viscus.

A tubercular urethro-rectal fistula would be found associated wit an irregularly nodulated prostate, probably an infiltration and nodulation of one or both seminal vesicles, with great thickening of th tissue lying between these two pouches, often induration and enlargement of the epididymis, and the presence of tubercular cystitis an tubercle bacilli in the urine. Urethro-rectal fistula occurs in malignant disease only when the infiltration is so well marked as to b practically unmistakable.

Prognosis.—The prognosis of urethro-rectal fistula in tubercula and cancerous cases is hopeless; even in simple ulceration, if ther has been much destruction of tissue, the chances of ultimate cure ar extremely slight. If the fistula is small it may heal spontaneousl especially after the relief of urethral obstruction, which has tende to keep it open. The consequences of an uncured fistula of thi kind are usually grave, since both the rectum and the bladder becom chronically inflamed, and are subject to the immediate and remot complications incident to such inflammation.

Treatment.—Spontaneous cure may take place after fistula-formation resulting from suppuration of a prostatic gland. This is rar One case was cured by directing the patient to urinate only when i the position of ventral decubitus. The most important point in treatment is to remove obstruction from the urethra. Although strictur is not a common cause of this form of fistula, when once the abnorma opening is formed a very slight urethral narrowing may be sufficient t keep it open indefinitely.

If restoration of the urethral canal to its normal calibre is n followed by cure of the fistula, the tract of the latter should be protected from the irritation incident to the passage of urine and fæce by regular catheterization, or, better still, continuous catheterizatio kept up for several weeks, and by the checking of diarrhœa and overstretching of the rectal sphincter. Perineal and ischio-rectal tracts together with their diverticula, should be opened, curetted, an forced to heal from the bottom by packing.

Duplay advises the introduction into the rectum of a silver canul furnished with an apron for the purpose of closing the fistulou orifice in the intervals of defecation.

The fistula still remaining open, repeated cauterizations of th rectal orifice and of the whole tract by a stick of copper sulphate o silver nitrate, or by the galvano-cautery, may be tried, but will succeed only in case the suppurating canal is very small.

These means having failed, a staff is passed into the bladder, an a probe is introduced into the rectum until it comes in contact wit this staff. External perineal urethrotomy is then performed, opening the urethra at the point where the fistula begins. The perineal incision is continued in such a way that the fistulous tract passing through the recto-vesical septum is cut transversely. The callous walls of the fistula are then thoroughly curetted, a permanent drainage-tube is passed from the perineum into the bladder, and the portion of the incision bisecting the fistulous tract is well packed with iodoform gauze. As a result of this operation the urine is diverted from its course before it reaches the rectal opening, and the latter frequently heals. The operation is sometimes successful in closing both the urethral and the rectal opening. In case one closes and the other remains, the operation appropriate to simple fistula will probably be successful.

A more radical method of procedure, and one giving a better prospect of success, is thus conducted. A curved incision is made across the perineum in front of the anus, this orifice lying in the concavity of the curve. This incision, identical with that employed for exposing the seminal vesicles, is deepened till the rectal and urethral orifices of the fistula are exposed and made accessible. In this dissection a finger introduced into the bowel and a sound passed through the urethra into the bladder will enable the surgeon to avoid wounding either the rectum or the urethra. The two orifices having been exposed, and the main tract and its diverticula having been opened, thoroughly curetted, and cleaned, the edges of each fistulous opening are extensively denuded and closed by catgut suture introduced as in the closing of vesico-vaginal fistula. When the tract is small and fairly direct and the surrounding tissues are healthy, the perineal wound may be closed by buried catgut sutures. When there have been much infiltration and suppuration, the wound should be packed and allowed to heal from the bottom.

In fistula dependent upon malignant disease such operations are not to be considered.

Urethro-Perineo-Scrotal Fistula.—This fistula, by far the commonest of all, is usually due to ulceration behind a stricture, though traumatism, erosion by stone or foreign body, acute abscess, ulceration extending from caries or necrosis of the pelvis, or tubercular or gummatous infiltration, may occasionally cause it. The urethral orifice is generally single, but externally there may be several openings; this being due to the fact that the one first formed has a tendency to contract slowly, thus obstructing the flow of urine, which then burrows in various directions. In cases of urinary extravasation from traumatism several fistulæ may be formed at the same time.

Occasionally the cutaneous orifices of the fistula are placed back on the buttocks, down the thighs, in the region of the hip, or in belly-wall, though usually they are found in the perineum and s tum. These fistulæ form dense fibrous tracts easily detected palpation. Some of these tracts end in blind pouches, others o externally. They are lined by unhealthy granulations, sometin though rarely, by epithelium. Occasionally in their interior cal are formed, or their walls are incrusted with urinary salts. skin and subcutaneous tissue of the scrotum and perineum are o enormously thickened, producing a condition much like elephanti About the fistulous orifices large fibrous nodules of partially organ inflammatory tissue may form.

Diagnosis.—The diagnosis is made easily. Pus and urine esc from the surface openings of the fistula, the skin of the perineum scrotum is inflamed and thickened, and the indurated tracts cha teristic of fistula are detected on palpation.

Frequently urine escapes from the opening in very small quan and acute inflammatory phenomena are entirely wanting. Un these circumstances blocking the urinary meatus during micturi may cause a few drops of urine to escape externally, or careful prol through the fistula, a steel instrument having been passed into urethra, may determine whether or not the skin sinus communic with this mucous channel.

Finally, the use of colored injections, or of hydrogen peroxide of the urethroscope, may be necessary before diagnosis can be ma

The differential diagnosis between urethro-perineal and perin anal fistula is founded on the history of the case; in the former stance there is usually a history of stricture, or at least of dysu followed by perineal abscess and escape of urine. Probing gener determines definitely the character of the fistula. The course ta by hydrogen peroxide or methyl-blue solution injected into the ternal opening under pressure will also usually settle the ma positively. Exceptionally it will show an opening into both urethra and the rectum. Finally, in the case of anal and re fistulæ examination conducted with a good head light and a sp ulum, the patient being in the knee-chest position, will nearly alw show the opening into the bowels.

Through perineo-scrotal sinuses kept open by caries of the pe bones there is no escape of urine. Moreover, by careful probing roughened bone often can be felt.

Sinuses dependent upon chronic suppuration of Cowper's gla or of the urethral glands can be diagnosed from fistulæ only by absence of urine leakage and the negative results of pressure injections.

Treatment.—The formation of these fistulæ may be prevented by prompt suture of the urethra in case the canal is ruptured or wounded either surgically or accidentally; by the immediate evacuation and packing of glandular and periglandular urethral abscesses, followed by continuous catheterization; and by the immediate dilatation of strictures as soon as they begin to give obstructive symptoms.

A perineo-scrotal fistula having formed, complete restoration of the urethra to its normal calibre is the first essential in successful treatment. The partial cure of stricture is in these cases unavailing. Usually when the calibre of the urethra is carried up to the point indicated in the scale given on page 220, the fistula, unless its walls are too densely indurated or have been covered with pavement epithelium, will heal spontaneously. At times continuous catheterization, supplemented by cleansing and stimulating the fistulous tracts, will accomplish a cure.

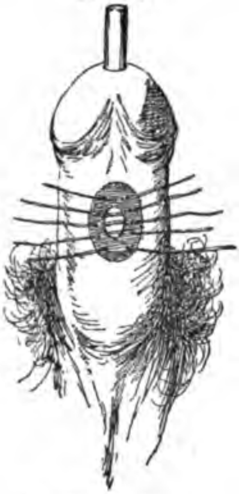
Since this variety of fistula, or at least its most intractable form, is rarely found except in conjunction with stricture at or about the bulbo-membranous juncture, it is advisable to restore the urethral calibre by external urethrotomy, employing continuous catheterization afterwards possibly for two or three weeks. This not only cures the stricture, but entirely diverts the urine from the fistulous tracts, thus giving them an opportunity to heal. If the latter are densely indurated, or crusted with the salts of urine, they should be laid open freely through their entire course, curetted, and packed with iodoform gauze, and allowed to heal from the bottom. Fibrous nodules, especially those placed about the urethra and in the skin openings of the tracts, should be excised.

Urethro-penile fistula is usually encountered as a short, straight, single, non-indurated channel, lined with pavement epithelium, passing by the shortest route from the urethra to the surface, though exceptionally, when the urinary extravasation has taken place from the mid-penile portion of the urethra, it may form a subcutaneous tract, running parallel with the course of the urethra and opening just behind the glans. Or the fistulous tract may pass backward and open near the root of the penis.

Treatment.—The restoration of the normal calibre of the urethra anterior to the fistula is the first essential of treatment, and will often be curative.

If the fistula persists, regular evacuation of the bladder by means of a catheter should be continued for a week, the urethra receiving an antiseptic flushing (boric acid four per cent., or silver nitrate 1 1000) after each passage of the instrument. If this fails, and if t fistula is direct and of small size, cauterization of the tract by t galvano-cautery may cure. This failing, the urethra should be th oughly freed about the margins of the opening, and the borders the latter having been freshened should be proximated by a row of catgut sutures (Fig. 9 another row of silk sutures is employed to br together the skin and underlying fascia. T dilating speculum or urethral dilator grea facilitates this operation. Undue tension on sutures and contamination by urine may be p vented by regular catheterization, or still m surely by perineal urethrotomy, the blad being drained through this opening till the fist is permanently closed.

FIG. 94.



Closure of fistula.

If the fistula is so large that closure by t operation would entail too great an encroa ment on the urethral calibre, a plastic operat will be required. A transplanted flap is usu taken from the scrotum; or one from the p puce or from the inguinal or abdominal reg may be employed. When the flap is taken fr the scrotum, a quadrilateral space about the fistulous opening freshened, a flap of similar shape, with its adherent base down raised from the scrotum, and its anterior and lateral borders sutured to the freshened surfaces. In a week the pedicle is divi and secured to the posterior border of the defect. To secure succ in these cases, regular catheterization or perineal urethrotomy necessary.

Probably the most efficient way of closing these fistulæ is by operation of double lateral flaps described as appropriate to the tre ment of hypospadia. (See page 79.) The short flaps are turned bringing the skin surfaces towards the urethra; then the long fla so freely dissected that they are subject to very little tension, brought together by sutures, their raw surfaces being apposed to raw surfaces of the inverted short flaps.

URETHRAL POUCHES.

In addition to the congenital pouches already described, there observed sacculations at the expense of the urethral wall, due eit to gradual yielding to vesical pressure or, more commonly, to ulce tion and abscess-formation, or to both these causes combined. The predisposing factor is inflammation incident to stricture, especially when there is a calculus lodged behind the stricture.

Symptoms.—The symptoms are sufficiently characteristic. There is long-continued dribbling of urine after apparent complete evacuation of the bladder. Examination shows either a sacculation or a dilatation in the course of the urethra, which is distended during the course of micturition, and which on being compressed becomes flaccid, urine at the same time dribbling from the meatus. In some cases, when the pouch contains a calculus, the latter changes position during urination, acting as a valve. Usually there are no inflammatory phenomena, and the tumor is compressible and painless, thus differing from chronic urinary abscess.

Treatment.—Treatment consists in extracting the calculus, if there is one, either by intra-urethral manipulations or by external incision. Strictures should be cured by gradual dilatation, or by urethrotomy, with perineal resection of the sac-walls if necessary. Simple diverticula behind the stricture are usually cured by wide dilatation. Exceptionally after cure of stricture the walls of the pouch must be resected and the opening into the urethra freshened and closed by suture.

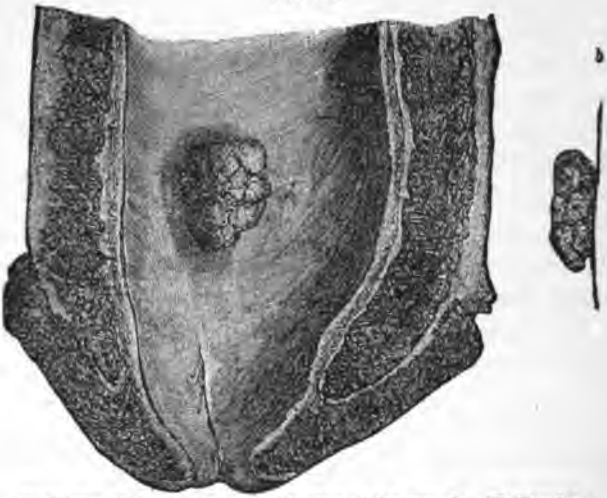
URETHRAL NEOPLASMS.

Papillomata (which the urethroscope has shown to be not so rare as was believed) appear as pedunculated or sessile, vascular, papillary outcroppings (Fig. 95), or as true polyps. They grow from any portion of the canal, but are commonly found in the navicular fossa and behind strictured portions of the urethra, springing from the floor. They are usually small, but exceptionally may attain a size sufficient to obstruct very considerably the stream of urine.

When they develop near the meatus, and this is their commonest seat, they are prone to grow outward, projecting from the urethral orifice as a soft, easily bleeding, fungating mass.

Symptoms.—These are usually slight, and are mostly mistaken for those of gleet dependent upon stricture. There is a thin, muco-purulent discharge, with slight burning during urination, and, if the polyp attains large size, interference with the volume and force of the stream. Often there is free bleeding on instrumentation, particularly in cases characterized by comparatively large areas of sessile, highly vascular papillary hypertrophy. The diagnosis is founded on an intra-urethral examination. The urethroscope shows these growths usually as slight villous projections, sometimes as raspberry-lik masses, occasionally as gelatinous pyriform tumors.

FIG. 95.



Papilloma of the urethra. b, side view of the growth. (Voillemier.)

Treatment.—This consists in removal of the growth by means o wire snare, or curette, or galvano-cautery, introduced through the e doscopic tube. If the polyp is snared or scraped away, the place fr which it was removed should be touched with glacial acetic acid pure carbolic acid. This operation is not difficult when the growt as is usually the case, are situated near the meatus. A dilating spe lum in these cases will prove more serviceable than the closed tu When the growths are deep, great difficulty may be experienced their removal.

Urethral caruncles are rare in the male urethra, but are oc sionally found near the orifice in the navicular fossa.

They consist of small, bright, red, pedunculated, highly-vascu papillated tumors, made up of connective tissue, covered by strati epithelium.

They are characterized by severe pain, aggravated by urinati and moderate muco-purulent, often blood-stained, discharge. T pain during sexual intercourse is so great as to be inhibitory. Inst mentation is intolerable.

They are distinguished from *irritable gonorrhœa* by the grad onset, independently of intercourse, and by the absence of gonoc from the discharge. The urethroscope will disclose the tumor.

The treatment consists of the complete removal of the little tu

—including its base—by means of small scissors, the wire ecraseur, or cautery knife. A meatus dilator will usually make the growth accessible, though a preliminary meatotomy may be needful.

DISEASES OF COWPER'S GLANDS.

On either side of the membranous urethra, between the two layers of the triangular ligament, is placed a pea-sized, lobulated, racemose gland, the duct of which, one inch long, perforates the anterior layer of the triangular ligament and empties into the bulbar urethra. These glands are sexual in function, and their secretion forms a part of the semen. Both they and their ducts, being lined by columnar epithelium, are readily susceptible to gonorrhœal invasion, and once having been infected remain fruitful sources of reinfection after an apparently cured urethritis. These structures cannot be reached by intra-urethral applications, nor are they amenable, because of their position, to massage. Chronic hypersecretion of Cowper's glands is a common source of intractable urethrorrhœa. As is the case with their homologues (Bartholin's glands), these structures are rarely infected by organisms other than the gonococcus.

Cowperitis.—Cowperitis, or inflammation of Cowper's gland, usually develops in the third or fourth week of an acute urethritis. It is due to an extension of the disease from the bulbous urethra, into which the ducts of these glands empty. All the causes which tend to aggravate an attack of acute urethritis, such as sexual or alcoholic excesses or violent exercise, predispose to inflammation of Cowper's gland.

Symptoms.—The first symptom is a sticking pain in the perineum; this is greatly increased by pressure, so that sitting or walking markedly increases the suffering. The swelling of the glands is resisted by the two layers of the triangular ligament between which they are situated and by the deep perineal fascia: hence, as the inflammation progresses, there is developed great tension.

Both micturition and defecation are painful, the suffering being particularly severe at the termination of the former act, since the transverse fibres of the compressor urethræ muscle, as they contract to expel the last drops of urine, compress the inflamed and swollen gland. If the swelling is very marked there will be some difficulty in micturition from mechanical pressure.

Usually but one gland is involved. It may then be felt as a small, hard, very tender tumor situated just behind the bulb,—that is, about the middle of the perineum. This tumor may be recognized by deep palpation of the perineum, or by pressure made in an upward and for-

ward direction by a finger inserted just within the external sphinc
The fact that this swelling is on one side of the median line constit
a distinct diagnostic point. When both glands are involved
swelling will, of course, be bilateral.

Suppuration sometimes occurs. When this involves the p
glandular tissues the skin will become reddened and œdematous,
the rigors, fever, and throbbing pains of pus-formation will be pres
The swelling in these cases is nearly always sufficient to inter
materially with micturition. The abscess usually perforates ex
nally, and on the discharge of a large quantity of pus heals kin
although it may subsequently be followed by troublesome cicatr
contraction. In rare instances the abscess may perforate into
urethra, but even then extravasation of urine is very exceptio
The inflammation frequently becomes chronic, lingering particul
in the gland ducts, and occasioning a discharge which is extre
hard to cure.

During the course of an acute cowperitis the discharge of the a
rior urethritis usually ceases or is greatly diminished in quantity.

Diagnosis.—When the case is seen early the anatomical posi
of the firm nodule or nodules renders diagnosis easy; but when
puration occurs, together with wide-spread periadenitis, it is someti
hard to determine the true nature of the inflammation.

It may be distinguished from a simple abscess of the perineu
the fact that the latter from its position cannot cause compressio
the bulb, and therefore difficult micturition.

From urinary infiltration following stricture it can be distingui
only by the history of the case. Periurethral abscess of the bu
farther forward than is the tumor in cowperitis, and is always i
median line.

Treatment.—Every effort should be made to lessen the ure
inflammation. Strong antiseptic or astringent injections or i
urethral manipulation must be discontinued at once. Rest in
prolonged hot baths, and the administration of a laxative or a s
purge are always indicated. A hot-water bag applied to the perin
relieves pain and seems to lessen the tendency to abscess-forma
When the suffering is intense, hypodermics of morphine driven
the perineum are indicated.

When throbbing pain, œdema, fluctuation, and rigors and
show that pus has formed, the abscess should be cut into at
and its cavity curetted and packed with iodoform gauze. Uri
extravasation, of course, demands immediate incision and drai
Fistulæ may be guarded against by permanent catheterization

the abscess has been opened and drained. When, in spite of every precaution, fistulæ form, and are not relieved by catheterization and free dilatation, excision of the fistulous tract, as well as of any remnant of the gland, and suture of the freshened edges, are required.

Cysts of Cowper's Glands.—Very few cases have been reported of cysts of the ducts of Cowper's glands. These usually form small tumors, projecting into the urethral lumen at the expense of its floor. If large, they may be detected by perineal or rectal palpation. In one case the tumor opened externally, discharging a viscid fluid at irregular intervals; this fluid was apparently secreted much more rapidly during coitus than at other times.

Cancer of Cowper's Glands.—Very few cases of this affection have been reported. The growth usually appears in the form of a cylindroma, forming a hard, movable, distinct encapsulated nodule. As it grows it becomes adherent to the surrounding parts. The inguinal glands are involved. The growth, at first painless and attracting little attention, rapidly increases in size and ultimately presses upon the urethra. Micturition becomes difficult, frequent, and sometimes painful. Defecation is interfered with, and sitting or walking increases suffering.

Diagnosis.—The characteristic feature of this affection is the position of the tumor. It is placed upon the bulb, is at first covered with healthy skin, and grows rapidly. Combined rectal and perineal examination shows it to be in the position which normally should be occupied by Cowper's glands.

Treatment.—Complete early removal would give the only hope of success, but will usually be impossible, since by the time the diagnosis is made and the patient submits to operation infiltration will have progressed too far. Death is likely to occur within the year, though there is one recorded case of survival without recurrence for nearly two years.

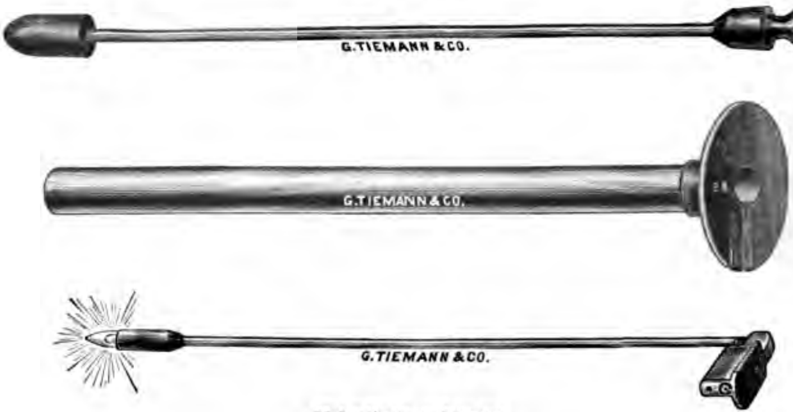
URETHROSCOPY.

Instruments constructed to allow of visual examination of the urethra are termed endoscopes, and are of various patterns. Of these the best are the ingenious electrical endoscopes devised by Valentine. (Fig. 96.) The aero-urethroscope is so planned that after introduction of the tube the urethra can be inflated with air, thus exposing a long, flat wall, in place of the small circle of lax mucous membrane which forms the field of vision in other instruments.

The light required in these examinations may be reflected from a head-mirror, or, far better, may be furnished by a small electric lar a very small, cold one, passed to the inner end of the tube. T electricity is furnished by a dry-cell battery, which can be obtained moderate cost.

The endoscopic tubes vary in calibre and length according to size of the urethra and the depth to which an examination must carried. It is evident that the shorter the tube and the wider calibre the more distinct will be the image presented. The tu vary in size from No. 22 to No. 32 French calibre, and may

FIG. 96.



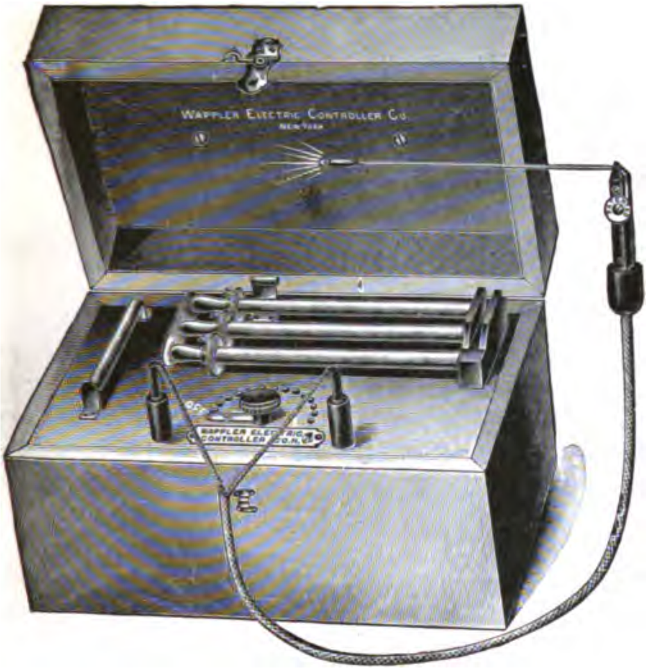
Valentine's endoscope.

longer as the calibre is wider; thus, No. 24 F. should be about th inches in length; No. 26, four inches; No. 28, five inches; No. five and a half inches; No. 32, six inches. The flattened disk at end of this tube enables even the shorter instrument to be carr almost, if not quite, to the membranous urethra, since after the tu is introduced to its full length the head of the penis is pushed ba by the disk on its end.

In addition to the endoscope, applicators are required, for purpose of removing secretions which may obscure the field of vis and for carrying medication to diseased mucous surfaces. These m be made of wire with cotton wrapped about their roughened ends, long, straight splinters of wood, or split straws barbed at the end, m be employed. Before beginning an examination a sufficient numb of applicators should be prepared. Several dozen may be required

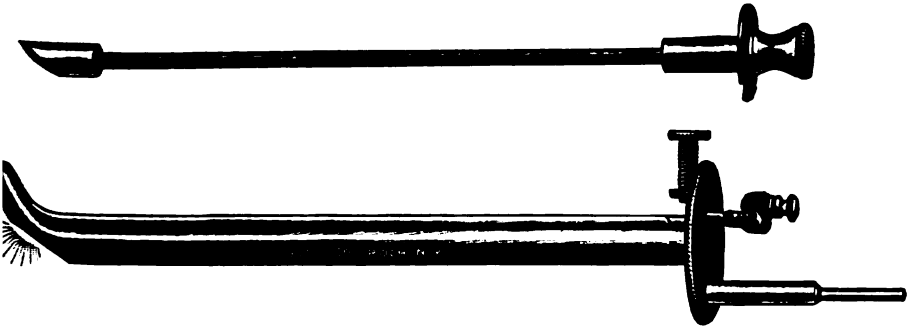
Examination.—This may be conducted with the patient in a ha sitting position in a chair or in a recumbent position upon a lounge a table. For a thorough examination the patient should be dra down to the foot of the table till his buttocks rest upon its lower edge. The thighs are separated and the feet are supported on foot-holders properly placed, or the legs and thighs may be allowed to hang. The surgeon then selects an endoscopic tube as large as the urethra will take, inserts the obturator, lubricates the instrument, and, drawing the penis directly upward from the body, separates the lips of the

Fig. 97.


Wappler Electric Controller Co.
New York
Wappler Electric Controller Co. N.Y.

Chetwood's urethroscope.

Fig. 98.



Swinburne urethroscope.

meatus and slowly introduces the tube by pressure upon the har of the obturator until it will go no farther. Unless there is strict or some abnormal obstruction, this would indicate that the roun end of the obturator has encountered the resistance due to the a rior layer of the triangular ligament and to the tonic spasm of compressor urethræ muscle. Usually this is as deep as it is necess to pass the instrument.

When inspection of the posterior urethra is indicated, the disk of the endoscopic tube is depressed between the thighs until the lies nearly parallel with the plane of the body. At the same gentle inward pressure upon the handle of the obturator is m By continued pressure the compressor urethræ may be made to yi and the instrument then passes into the prostatic urethra. It can passed completely into the bladder, but when the posterior uret must be inspected, a tube with a curved end, the convexity of whic fenestrated, causes less traumatism.

The tube having been introduced to the required depth is hel place by the fingers of the left hand, while with the right the o rator is withdrawn and the illuminating apparatus secured in pl The field of vision is usually obstructed by pus, mucus, or bl Such fluids must be removed by means of the cotton applica before a clear view can be obtained.

The inspection is conducted by slowly withdrawing the tube, u the cotton applicators to cleanse exposed surfaces from discharge. case the instrument has been carried in as far as the internal ves sphincter, the disk is elevated as it is withdrawn, so that the e scopic tube shall correspond in direction to that of the urethra. the penile portion of the urethra is inspected, the disk is withdra from the glans, and the penis, sagging down, may prevent the of the endoscope from being concentric with the urethral canal the weight of the penis may cause it to drop entirely away from endoscope. To prevent this, as the instrument is drawn out thumb and finger of the left hand shift their grasp from the disk the tube, while the penis is supported between the ring and fingers of the same hand.

Urethral stricture or a small meatus may temporarily prevent introduction of an endoscopic tube. Instrumentation or cuttin then indicated to bring the urethra to its normal calibre. Bleeding seriously interfere with a satisfactory urethroscopic examination. if slight will stop spontaneously, or may be checked by cotton ap cators soaked with a two per cent. eucaine in a 1 to 1000 adren solution applied on a swab. Profuse bleeding generally comes an inflamed posterior urethra, and is due to the bruising occasioned by the passage of the instrument.

The urethroscopic examination should be preceded and followed by an antiseptic flushing of the anterior urethra.

Appearance of the Urethra.—In an examination of the urethra the following points are to be carefully considered (Grünfeld):

1. The cone-like figure which the urethral walls assume beyond the end of the endoscope. This is due to the natural elasticity of the urethra and the contraction of its muscular fibres.
2. The color, the thickness, and the vascularity of the walls of this cone.
3. The central point or figure, that is, the appearance presented by the closed lumen of the urethra which forms the apex of the cone. The form, the size or length, and the position of this figure are important.

Every portion of the urethral mucous membrane must be subjected to careful examination. In inspecting the cone and its apex, the central point or figure, the endoscopic tube is kept parallel with the urethral axis at the point of examination. For more direct inspection of the urethral walls, however, it becomes necessary to give the endoscope a different relative position. When the endoscope is turned slightly away from the axis of the urethra, thus exposing more directly the parietes and carrying the central figure towards the periphery of the picture presented, the position is said to be eccentric. When the endoscope makes such a distinct angle with the urethral axis that the central figure disappears entirely, and in place there is seen a flat surface of the urethral wall, the position is said to be parietal. Thus the upper, the lower, and the lateral walls of the urethra are inspected directly each time a new urethral surface is exposed by drawing out the endoscope for one-quarter to one-half inch. In making a complete examination, it is well by varying the pressure to alter the relations of the cone and central figure to the urethroscopic tube, now slightly withdrawing, now slightly pushing it in.

Starting from the prostatic portion of the normal posterior urethra and using a full-sized urethroscope with a curved end, a surface of dark-red mucous membrane is observed. As the instrument is withdrawn rather suddenly there rises from directly below, if the endoscope is held precisely in the middle line, or from one side when the instrument is lateralized, a smooth, rounded, polypoid mass, the caput gallinaginis. This fills the greater part of the field of vision and is of a brighter red than the surrounding urethra. If the distal end of the

urethroscope is now raised somewhat so that this projection occu
almost the entire field of vision, the opening of the sinus pocula
sometimes sealed by a drop of viscid matter, can often be seen.
the endoscope is still further withdrawn, the ridge projecting in adva
of the sinus pocularis forms a distinct fold on the floor of the uret
over which is stretched the mucous membrane of the roof and si
of this canal, forming a crescentic fold less distinctly marked fr
behind forward. The mucous membrane becomes finally less re
the membranous part of the urethra is reached.

For inspection of the anterior urethra a straight endoscopic tub
used. If the end of this instrument be introduced just within the gr
of the compressor urethræ muscle, a punctate central figure is form
with radial folds of mucous membrane extending from the periph
towards it. The endoscope being withdrawn, its end escapes from
grasp of the compressor urethræ muscle, and unless the instrument
held firmly may be thrust strongly forward by the contraction of
ischio-cavernosus and bulbo-cavernosus muscles. If, however, the
tremity of the endoscope is retained in the region of the bulb, its di
extremity being at the same time carried upward so that it stands at ri
angles to the plane of the body, the action of these muscles can be
tinctly seen in the alteration which takes place in the central fig
This in place of appearing as a cone is converted into a vertical
with mucous membrane bulging forward on either side. This chang
form is due to the lateral pressure produced by the bulbo-caverno
and ischio-cavernosus muscles. The mucous membrane is here
red, but from pressure of the instrument may be made to app
almost white. As the urethroscope is slowly withdrawn, and as
extremity passes into the pendulous urethra, the figure presente
again conical, the central figure appearing as a transverse slit, w
radial folds of various depths. The color is a pale red. On press
of the instrument the openings of the glands and follicles can rea
be seen as minute pin-point spots, perhaps a little deeper in color th
the surrounding mucous membrane. As the urethroscope reac
the navicular fossa the central figure again changes in shape, appe
ing first triangular, then at the meatus as a vertical slit; the muc
membrane becomes purplish in color.

The Use of the Endoscope.—During the acute stage of urethritis
use of the endoscope is undesirable; when, however, the disease
become chronic and when, in spite of well-conducted and sufficie
prolonged treatment, discharge or other symptoms persist, an en
scopic examination is often useful.

The appearance presented by the pathological urethra is sim more or less a modification of that already described as characteristic of the normal canal. The conical field, the color, and the central figure are all altered. Thus, when the inflammation is subacute the mucous membrane is greatly swollen, soft, and succulent, and the normal cone is practically obliterated, the walls of the urethra coming directly together, sometimes even projecting into the lumen of the endoscopic tube. When the subepithelial infiltration has undergone organization the cone-like figure becomes greatly elongated, and the central figure may be triangular, quadrilateral, or in other ways irregular in shape.

Color alterations are usually marked. The tint becomes dark red or even purplish, and may appear in patches or may invade the greater part of the urethra. In place of the normal lustrous urethral surface the mucous membrane may appear either shining and œdematous or dull. Exceptionally the surface is granular, either over a considerable area or in localized patches.

The openings of Morgagni's follicles are often large, patulous, and purplish. Sometimes there are distinct epithelial outgrowths. Areas of corneous epithelium indicative of subepithelial cicatrization appear as white patches. In chronic inflammation of the posterior urethra the mucous membrane is purplish, swollen, œdematous, hypersensitive, and bleeds readily.

The endoscope will thus enable the surgeon to discover and locate circumscribed areas of inflammation, chronically inflamed lacunæ and follicles, subepithelial infiltration, vegetations or polypi, strictures, and urethral calculi. Through it strong applications may be made to diseased areas. Suppurating follicles may be readily split up and cauterized. The nature and position of foreign bodies may be determined. Polypi may be removed. The anterior opening of eccentric strictures may be discovered.

THE CARE OF URETHRAL INSTRUMENTS.

The instruments used in urethral surgery are of metal, woven thread coated with gum, india-rubber, or whalebone. The metal instruments include the knives, urethrotomes, urethroscopic tubes, sounds, and catheters.

The knives, and especially the small blades used in the urethrotomes, should have a smooth razor edge, and should be freshly prepared for each operation. They are sterilized by boiling in soda solution (one to three per cent.) not longer than one minute, as prolonged boiling invariably blunts a keen edge. If they have b carefully cleansed by soap and hot water and are free from rust, minute's boiling is sufficient to render them sterile.

The urethrotomes are boiled for ten minutes in soda solut but before being immersed are carefully tried to see that they w smoothly and easily. Immediately after being used they should taken apart completely, scrubbed in hot water and green soap, d out of boiling soda solution, and put together. It is well to place th in an oven at about boiling temperature for five minutes to ins thorough drying. They should then be wrapped in dry sterile ga and stored in drawers, or, better still, in a dry closed box.

The urethroscopic tubes are either silver- or nickel-plated; t are sterilized by boiling in soda solution or by flaming with alco After use they are washed and swabbed out with hot soap and wa washed in soda solution, and thoroughly dried. Their outer sur must be perfectly smooth, and the obturator must fit the ureth opening accurately. The edges of the latter should be bevelle slightly. It is well to keep each separate tube wrapped in ste gauze, thus preventing denting or bruising of the plating.

The sounds and metal catheters must present a perfectly smo polished surface. The slightest irregularity which can be detected the sense either of sight or of feeling is sufficient ground for hav the instrument reburnished or replated. These instruments sho be kept in boxes or racks so arranged that each instrument is firmly in its place and is not liable to bruise or dent its fellows. sounds may be sterilized either by boiling in soda solution or by b dipped in alcohol to a depth sufficient to wet all the instrument cept the handle. The alcohol is then ignited, and in burning ca enough surface heat to render the sound sterile. Before this flam instruments should be polished for a moment by brisk friction wi clean towel. Metal catheters should be sterilized by boiling in s solution. Before subjecting them to this process it is well to assured that their canals are not blocked, and in the case of Gouley catheter that the obturator is movable, and that the "tun is sufficiently large to accommodate the filiform bougie over whic is to be passed. After having been used the catheters should cleansed immediately.

None of the lubricants commonly employed injure metal ins ments. The lubricant chosen should be placed in a narrow sp men jar so deep that the entire shaft of the instrument can be dipp By placing this jar in the steam sterilizer for ten minutes every its contents can be kept absolutely sterile. Of the oily substan fluid albolene and castor oil are the best. The objection to these and similar lubricants is based upon the fact that they make the subsequent cleaning of the instruments difficult, and in the case of soft gum and rubber instruments produce a rapid deterioration in their strength and surface polish.

We have been well satisfied with the following preparation, which is not irritating, and is easily removed by water:

℞ Boroglyceride, ℥iii;
Aquæ destil., f℥ix.
M. S.—Use as a lubricant for sounds.

The soft urethral instruments, india-rubber and woven gum-coated bougies, catheters, and whalebone filiforms, are much more difficult to sterilize and to keep serviceable than are the metal instruments. The flexible india-rubber catheters are, fortunately, rather benefited than otherwise by boiling in water: hence their thorough sterilization is readily accomplished. All fats act injuriously upon the rubber, causing it to swell and soften and to become so weak that it is unsafe for use. This action is not noticeable for several weeks. Ultimately these india-rubber instruments if unused become brittle. They are so cheap that they can be replaced readily when they show signs of deterioration. The woven bougies and catheters are coated with a varnish which should exhibit an absolutely smooth finish. The best are those made so that they can withstand the temperature of boiling water, though if frequently subjected to this process, or if the boiling is long continued, the varnish becomes irregular and blistered. If the mechanical cleansing of these instruments is efficiently carried out, boiling in water for five minutes is sufficient to sterilize them. Each should be separately wrapped in sterile gauze before being boiled.

Janet and Guyon found formaldehyde to be an efficient antiseptic for the sterilization of urethral instruments. The method of applying the disinfectant is as follows.

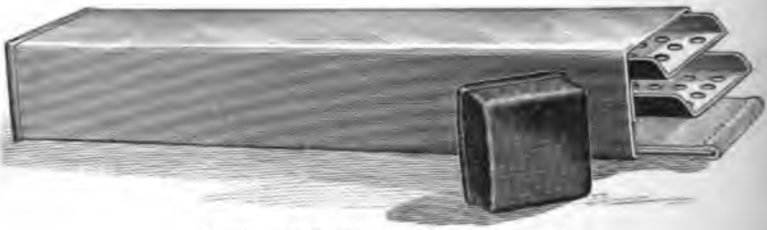
A metal box is made varying in size in accordance with the requirements. (Fig. 99.) That designed for genito-urinary clinics or for the specialist is eighteen inches long, seven inches wide, and four inches high, hermetically closed by a metallic cap with a rubber washer, and provided with eight shelves made of perforated metal. These shelves can be stored in the upper part of the box when they are not required. In the bottom of the box there is a frame upon which can be stretched a piece of cloth twelve inches long and four inches wide. This cloth is placed above the floor of the box, and thus allows of rapid evaporation of the formaldehyde which is poured

upon it. Upon this cloth can also be spread finely powdered pa
form ; it should be sprinkled in a shallow layer over the entire surfa
This apparatus readily holds two hundred instruments, each of whi
can be kept entirely separate from the others.

A similar box is designed for patients who are required to steril
their own sounds and for doctors who only occasionally use instr
ments. This is seventeen inches long, three inches high, and thr
inches wide. One end is closed by a soft rubber cap. It contains t
shelves,—the upper movable, the lower fixed,—and, below, a moval
frame over which a cloth can be stretched or a layer of absorbe
cotton spread. This allows of the sterilization of from sixteen
twenty instruments. It is also large enough to contain a cystoscop

The box designed for patients who are required to sterilize th
own catheters should be of such size that a sufficient number can
stored to last two days, a fresh instrument being used each time.

Fig. 99.



Sterilizing-box for soft urethral instruments.

A diploma case, provided with a central removable core of wire
perforated metal, divided into the required number of compartmen
answers well. In one cap of the case is placed a pledget of absorbe
cotton, and on this is poured one drachm of formaldehyde (forty
cent.). The cap is then placed on and fastened with adhesive plast
The catheters are boiled, dried, placed in the compartment, and t
box closed.

Formaldehyde is particularly adapted to the sterilization of boug
and catheters of large calibre, an exposure of twenty-four hours bei
sufficient. There may, however, be failure when small quantities
formaldehyde are employed, when the temperature of the surroundi
atmosphere is low, or when an attempt is made to sterilize sm
catheters with very fine canals, or irrigating cystoscopes. It is probab
that all these instruments could be thoroughly sterilized by a mo
prolonged exposure,—forty-eight to seventy-two hours. It is essent
to employ formaldehyde of full strength (forty per cent. volume in sol
tion), spread over a considerable surface, to keep the temperature

the surrounding atmosphere above 56° F., and not to attempt to secure sterilization in a shorter period than twenty-four hours for large-calibred catheters, or forty-eight hours for catheters of fine calibre and for simple cystoscopes, which must have been washed previously. Irrigating cystoscopes and ureteral catheters cannot be sterilized certainly except after much longer exposure.

After prolonged exposure to formaldehyde instruments remain as smooth, supple, and shining as when they were first subjected to the influence of the antiseptic. No action is perceptible upon the metallic portions. Ultimately flexible bougies become somewhat softer than at first, probably because they are kept in a moist atmosphere. The softening is so slight that it is of no serious consequence.

Instruments taken directly from a strong formaldehyde vapor and introduced into the urethra occasion a slight stinging sensation. This is avoided by a preliminary washing in boric acid solution.

As to the preservation of soft instruments, in all cases they should be carefully washed with soap and water within and without and dried as nearly as possible before sterilization, then subjected to the formaldehyde solution (forty per cent.) for at least twenty-four hours. When required for use they are taken out and immediately submerged in weak antiseptic solutions, biniodide of mercury 1 to 25,000 or boric acid four per cent. answering well.

If the patient is required to pass an instrument on himself, say four times daily, he should have eight catheters in the small box already described. Four of these catheters are placed upon the upper shelf and four upon the lower, and trioxymethylene is put in place. Each time an instrument is used the patient takes one catheter from the upper shelf. After having drawn his water, he washes the catheter and puts it aside. The next day the four catheters that have been used are soaped and washed, dried as thoroughly as possible, and put back upon the upper shelf, the patient then proceeding to utilize those upon the lower shelf. The cap should be removed and replaced as rapidly as possible each time, and a drachm of formaldehyde solution should be spread over the cotton once daily.

For the general practitioner who rarely employs catheters, it is best to place the instruments that he is most likely to use in the sterilizing box and leave them there indefinitely until they are required. The formaldehyde diffuses in two or three days, and there is then no need to dip the instruments into a mild antiseptic solution before they are used.

Whalebone filiform bougies may be conveniently sterilized by the formalin process. In storing these instruments, it is well to remem-

ber that they are attacked by a parasite, which so roughens
weakens them that they become unfit for use: hence they should
slightly lubricated with albolene or cosmoline and kept in a tight b

The rules applicable to the care of soft instruments are that t
should be kept straight and not coiled; that they should not
allowed to lie in contact with one another, this being prevente
wrapping each in sterile gauze; that they should be thorou
washed, and, in the case of catheters, flushed out, immediately
being used, and be dried by wiping, shaking, and finally by expo
to dry heat at about 150° F. They should be thrown aside as s
as the surface becomes rough, irregular, or blistered.

CHAPTER VIII.

THE GENERAL SYMPTOMATOLOGY OF DISEASES OF THE URINARY TRACT.—EXAMINATION OF THE URINE.

Pain.—Pain symptomatic of pathological conditions of the urinary tract is subject to so many variations in degree, is so often referred to regions other than the seat of disease, and is so affected by vesical tension and by micturition, that a serviceable classification of the manifestations of this symptom is difficult. Perhaps the subject may be best considered under the following heads:

1. The character and intensity of pain.
2. The region of pain.
3. The relation of pain to the act of micturition.

The Character and Intensity of Pain.—Pain symptomatic of urinary affections may vary from an apparent muscular stiffness comparable to that following active exertion, and noticed only on movement, or from a dull ache readily forgotten when the mind is employed, to a severe pain distracting the attention and seriously interfering with the business of life, or to an unbearable anguish producing vomiting, syncope, and sometimes death.

The pain may be aching and rheumatoid, as in renal congestion, may be burning, as in cases of prostato-cystitis, may be shooting and lancinating, as in vesical neuralgia, or may be tearing and griping, as in renal colic.

It may be steady, as in vesical carcinoma, it may be intermittent, as in bladder stone, or it may be continuous with violent exacerbations, as in calculous pyelitis or acute hydronephrosis. If the suffering incident to acute blocking of the ureter be excepted, most of the pain of urinary disease comes from the bladder and prostatic urethra.

Diseases of the kidney and its pelvis are comparatively painless, provided there is free drainage through the ureter. A calculous pyelitis may last for years with no symptoms other than backache, aggravated on motion, or there may be frequent paroxysms of agonizing pain, and indeed this may occur in pyelitis without calculi. These paroxysms are due to acute retention, caused by valvular formation, plugging of the ureter by pus or blood, or blocking of it by calculus.

Inflammation of the ureters in itself occasions no pain which can be recognized as characteristic. It is, however, so frequently complicated by partial or complete stoppage, with consequent tension the kidney capsule, that patients suffering from this form of infl mation are subject to violent attacks of colic. The absolutely unb able pain of a kidney stone passing along the ureter is probably more to spasmodic mechanical blockage of this canal and consequ retention of urine in the kidney pelvis than to mechanical eros caused by the passage of an irregular foreign body. This hypoth would seem to be confirmed by the comparative painlessness ureteral catheterizations.

The pain of bladder-disease, aside from that caused by musc contraction incident to micturition, is proportionate to the inter of the pathological process. Chronic cystitis causes very little p Acute cystitis and acute retention are extremely painful.

The suffering incident to inflammation or erosion due to a ca lus or a foreign body varies greatly. In general, large smooth ca are less painful than those which are small and irregular. Malig growth of the bladder may be absolutely painless until it beco complicated by cystitis or infiltrates the muscular walls. Even u these circumstances pain may be slight or bearable. It is often, h ever, constant, subject to spasmodic exacerbations, and more int and wearing than any other form of vesical pain except that du retention.

Tubercular ulceration may be painless, except during and micturition. When the lesions are situated in the trigonum they cause constant burning wearing pain, with reflexes to the rec anus, perineum, and inner surfaces of the thighs.

The Region of Pain.—Pain may be felt in the region invol Thus, in acute hydronephrosis or chronic pyelitis the pain is stantly referred to the region of the kidney, though reflexes ma so pronounced as to make this fact apparent only after careful q tioning of the patient. Inflammation of the bladder usually ca pain directly in the vesical region.

Sometimes no pain is experienced at the seat of lesion, the ab mal sensation being referred to anastomosing nerve-trunks or to terminal extremities of the nerve irritated. Thus, disease of the neys constantly gives rise to pain which is felt chiefly in the g down the thighs, or in the testicle. The irritation caused by sto the bladder produces urethral pain, felt a short distance back the meatus. Inflammation of the trigonum frequently causes itc tickling, and painful spasm of the anal sphincter.

Occasionally the healthy bladder may be the seat of almost bearable pain, due entirely to inflammation of the kidney pelvis.

The pain of kidney-disease of one side may be referred to the opposite healthy side, or to the shoulder, the groin, the urethra, the testicle, the inner surface of the thigh, the calf, or the heel. This pain in the heel is particularly a reflex from the prostatic urethra.

Pain of bladder-trouble may be referred to the suprapubic region, the sacral or lower lumbar vertebræ, the glandular urethra, the kidneys, the perineum and anus, the inner surface of the thighs, and the sole of the foot. All these transferred pains may be symptoms of inflammation of the prostatic urethra.

Diffuse suprapubic pain generally indicates disease posterior to the vesical sphincter.

If *constant*, it will suggest advanced vesical atony, vesical carcinoma, severe chronic cystitis, perivesical abscess or inflammation, and rarely ureteral disease.

If *transient* in duration and *provoked by micturition*, it suggests prostatic enlargement with residual urine. When *increased by micturition*, it generally means vesical tenesmus in a partially atonic bladder. The transient suprapubic pains of all grades of cystitis, tuberculosis, and ulceration of the bladder and of chronic prostatic inflammation are all relieved by micturition.

Perineal pain always signifies disease of some structure in intimate relation with the bladder-neck, or base, or of the prostatic or membranous urethra.

If *constant*, chronic prostatitis, beginning prostatic hypertrophy, carcinoma, and encysted calculi are suggested. If *transient* and relieved by micturition, acute inflammation and tubercular disease of the prostate or vesical trigone must be considered. When increased by micturition, it suggests either inflammation posterior to the vesical trigone, such as might be caused by calculi pouched behind an enlarged prostate, or tubercular infiltration, or involvement of the bulbous or membranous urethra, such as would result from suburethral abscess, or inflamed stricture, carcinoma, or—rarely—tuberculosis.

Pain referred to the glans penis, whether constant or occurring only at the beginning or during the act of micturition, always implies disease of some part of the urethra or the prostate.

If constant, prostatorrhœa, chronic inflammation of the prostatic urethra, or beginning enlargement of the prostate gland is indicated.

If occurring just before micturition, urethral obstruction either from clot retention, calculous impaction, or senile prostatic enlargement is present.

If present throughout micturition, it may be due to some local

lesion in the urethra; either inflammation, a granular patch, u
tion, neoplasm, or a narrow meatus.

If present only at the end of micturition, it may be due to a
logical condition at or near the internal (vesical) orifice of the ur
such as severe prostatic inflammation or congestion, vesical t
impinging on the internal urethral orifice, inflammation of the tr
ulceration of the posterior or lateral walls of the bladder, any fo
acute localized inflammation in any part of the bladder causing
involving the neck, vesical calculus, or the vesical spasm of renal

The Relation of Pain to the Act of Micturition.—Pain m
experienced before, during, or at the completion of the act of
rition. The pain may be felt in the bladder, urethra, deep peri
and rectum, or in the regions already described as the seats of
ence for reflexes. It is subject to variations. It may be sim
slight ache, or may be burning, shooting, darting, neuralgi
almost unbearable.

Even though reflexes are present, the pain is usually loca
the seat of disease, and is generally more or less persistent, t
of urination exaggerating it.

Pain preceding micturition is due to a hyperæsthetic con
of the vesical mucosa or the prostatic urethra. This hyperæs
may be caused by various neuroses, by congestion, or by infla
tion,—the tension of the full bladder causing distress. If the u
strongly acid or concentrated, as in cases of rheumatism, go
acute fevers, even the healthy mucosa may be irritated, an
be the seat of burning or discomfort, relieved by emptying the bl
Exceptionally pain before urinating is a symptom of disease
kidney pelvis.

Micturition pain is also occasioned by irritable or inflamm
conditions of the bladder or prostate, since the muscular contr
required to expel urine necessarily disturbs the hypersensitive ti
Ulceration or inflammation of the vesical neck is particularly lia
cause urination pain. The sensation may be aching, burni
shooting and darting, distinctly neuralgic in type.

Pain after urination, generally considered characteristic of
may be caused by any inflammatory or ulcerative condition
bladder-neck. In many cases it is probably due to fissure or er
and is comparable to the pain felt after defecation in cases o
fissure. The probability that this is the cause of the severe
of suffering is still further increased by the fact that it is com
associated with tenesmus and involuntary contraction of a
perineal muscles, and that it is relieved by local applications.

Aside from pain due to distinct lesions of the urinary tract, there is apparently a pure neurosis characterized by continuous or intermittent pain amounting sometimes to veritable anguish felt in the bladder, suprapubic region, or perineum, by frequent urination, and, unless the desire to empty the bladder is at once gratified, by incontinence. There is usually nocturnal remission, the patient sleeping soundly for several hours. The symptoms vary in intensity; active pursuits, either of mind or of body, caused marked temporary amelioration.

Exploration proves the urethra and bladder to be exquisitely sensitive. This condition is termed irritable or neuralgic bladder, and is sometimes a symptom or prodrome of tabes, though it is more commonly a reflex from the rectum, anus, or generative organs. It has been observed in association with influenza, rheumatism, gout, and malaria.

When pain at the end of urination is greatly increased by exercise or jolting, and is relieved by rest in bed and by urination in the dorsal decubitus, it is probably due to calculus or to foreign body.

The pain at the end of micturition caused by tubercular ulceration at the neck of the bladder, or exceptionally by cystitis, may also be relieved by rest and be aggravated by motion, but not to the same extent as is observed in calculus.

Chronic inflammation of the prostate is usually characterized by a more or less constant pain referred to the sacrum. In seminal vesiculitis this pain is referred to the hip-joint. In nephritis or pyelitis it is referred to a point just below the last rib to the outer side of the erecta spinæ muscle and is not affected by the act of micturition.

Frequency of Urination.—Most men empty the bladder upon rising in the morning, during the after-breakfast defecation, at noon, in the late afternoon, and before going to bed, passing from six to twelve ounces of urine at each act of micturition. In warm weather urination is less frequent, the skin relieving the kidneys.

The bladder is said to be irritable when the desire to urinate comes too frequently. This irritability may be entirely of psychic origin,—as, for instance, the frequent micturition of the student subject to examination,—or it may be due to habit, though, unless the frequency be continued through the night, this does not lessen the absolute capacity of the bladder.

The irritability may also be caused by reflexes from the rectum, the urethra, the prostate, the testicles, or the kidneys.

It may be due to increased secretion on the part of the kidneys, as in diabetes. In this case the bladder is not, properly spe irritable, since it contains urine comfortably up to its full n capacity, but has to be frequently emptied because it is so r filled.

The frequency of quantity and of irritability are thus tab by Fenwick:

A.—*The Frequency of Quantity.*

(Much urine, which is passed often.)

Persistent excess.	High specific gravity.	Sugar.	Diabetes mellitus.
	Low specific gravity.	No sugar, but extreme thirst.	Diabetes insipidus.
		Albumen with casts, but without pus or residual urine.	Chronic Bright's d such as granula ney, amyloid kid advanced scroful syphilitic affectio
		No albumen, but with residual urine.	Back renal pressur atony or direct irritation of pr origin.
Transient excess (usually diurnal).	Low specific gravity, clear.	(*a*) Sexual excess or debility (without inflamm Dietetic idiosyncrasy,—tea, beer, etc. (*b*) Hypochondriasis, hysteria, nervousness.	

B.—*The Frequency of Irritability.*

(Little water, which is passed often.)

1. Without obstruction to the stream.	(*a*) Without pus.	Blood, lithiasis, phosphaturia, oxaluria, dyspep
	(*b*) With pus.	Various irritants in renal pelvis and ureter, stone, tubercle. Movable kidney. Cystitis grades. Catarrhal or tubercular ulceration bladder. Hard cancer.
	(*c*) With prostatic "threads" of pus.	Micturition reflex, excited by transient inflam or congestion of the prostatic mucous membr *e.g.*, gout, catarrhal prostatitis, masturbation tatic tubercle, and stone.
2. With obstruction to the stream.	Diurnal.	Stone, stricture, prostatitis, muscular atony degree, vascular growths of female urethra.
	Nocturnal.	Enlarged and congested prostate without much ual urine.
	Diurnal and nocturnal.	Enlarged prostate with residual urine. Can prostate.

C.—*Physical Irritability.*

The frequency of incapacity.	Frequency at night nearly as pronounced as in day.	Non-inflammatory conditions.	Contraction due to habit.
		Inflammatory conditions.	Contraction due to obsolete or advanced tubercle of the bladder; to advanced interstitial cystitis following gonorrhœa, stone, enlarged prostate, perimetritis.
The frequency of overflow.	Age, 30–45.	Spinal atony (tabes), advanced stricture.	
	Age, 45–70.	Advanced atony of prostatic enlargement.	

The treatment of frequent urination is founded on the detection and removal of the cause, and is given in the sections devoted to the consideration of cystitis, stone, stricture, cancer, etc.

There is, however, one form of frequent urination which apparently is purely functional. In the absence of urethral lesions or pathological conditions of the urine the patient is unable to retain his water more than one or two hours at a time. The desire to urinate, if not immediately gratified, becomes irresistible. The bladder is completely emptied at each act of micturition. There is usually moderate polyuria.

This condition may be due to masturbation, may follow sexual excess or prolonged sexual excitement, or may develop without appreciable cause. It usually affects young unmarried men. In the cases we have observed from four to six ounces could be retained comfortably; efforts to retain more than this caused great distress. In one case between seven and eight ounces of clear urine of low specific gravity (1010) were passed every one and a half to two hours during the day. The desire to urinate, if resisted, caused so much suffering that the patient was unable to attend dinners or any form of social entertainment which would prevent him from urinating the moment he felt this inclination. His sleep was uninterrupted, and if his bladder was emptied immediately on rising he experienced no distress, usually passing from twelve to twenty ounces.

In deciding that this frequent micturition is purely functional it must be remembered that a similar bladder-irritability is sometimes symptomatic of spinal sclerosis, particularly that form associated with exaggerated reflexes: hence bladder-symptoms should always lead to an investigation as to the condition of the central nervous system.

A bladder abnormally small from congenital formation, long-continued nocturnal and diurnal incontinence, or from tricial contraction, may cause a form of frequent urination diffic distinguish from that which is purely functional. The frequen due to contracted bladder, will necessarily be both nocturnal diurnal, and a test of the vesical capacity by means of sterile i tions will demonstrate the nature of the affection. It must be rer bered that the frequency of polyuria is normal, hence the quanti urine which the patient passes must be known.

The treatment of this purely functional frequency is at first m dietetic and hygienic. Since the desire is often not felt when mind and body are actively engaged, riding the bicycle seems pa larly serviceable, both for its direct effect and for its general influ on the health. All causes of prostatic congestion or hyperæst must be removed. Sexual excess, prolonged sexual excitement constipation are to be avoided most carefully. Daily cold ene of salt water (a drachm to the pint) are serviceable as mea emptying the lower bowel. Hemorrhoids should be cured, dundant foreskin removed, varicocele relieved by a suspenso subjected to radical operation; in fact, every possible cause of excitability should receive attention.

The local treatment has for its object the relief of hyperæst and congestion of the prostatic urethra. This is accomplishe full-sized cold steel sounds, the direct application of electricity, i lations, rectal irrigations, applications of heat or cold, and pro massage. The details of these methods are given in the sectio voted to the treatment of impotence.

The medicinal treatment should be confined in the main to structives, tonics, and stimulants. Potassium bromide theoret should be serviceable, since it lessens reflex excitability. We generally found it useless. Hyoscine and hyoscyamine in dos from one two-hundredth to one one-hundredth of a grain thrice and belladonna suppositories, each containing one-third of a gra the extract, have given us better results than any of the many commended.

It should be clearly recognized that this affection when it has of long standing is extremely obstinate to treatment, and that cu it can be accomplished at all, is at the expense of months of pa not too officious, treatment. Marriage, with its consequent regu of sexual relations, favorably affects, or even entirely cures, this of frequent urination.

Frequent urination due to a bladder small from conformati because of prolonged non-retention (habit frequency) is best treated by daily progressive dilatation, accomplished by means of a fountain syringe, elevated three feet above the bladder, and a short urethral nozzle or soft rubber catheter. The urine is passed, and the bladder is then distended with warm sterile four per cent. boric acid solution till further injection becomes unbearable to the patient. The injected liquid is allowed to flow out slowly, and the distention is repeated. This treatment is repeated daily or every second day till from eight to twelve ounces of urine can be retained comfortably.

Hydraulic distention is absolutely inadmissible when the bladder-cavity is lessened because of tubercular involvement.

Alterations in the Stream.—Urine driven by a healthy bladder through a normal urethra should, unaided by abdominal strain, flow from the meatus in a steady twisting stream, which, if it be directed horizontally forward, should fall from three to five feet away from the vertical line of the body. When the muscular walls of the bladder are weakened, or when the urethra is obstructed, this stream is necessarily altered in volume, force, and direction. Irregularity in muscular effort or sudden blockage of the urethra breaks the continuity of the stream.

A small, forked, badly aimed, but forcible stream points to narrowing at or near the meatus.

A forcible, large stream, suddenly and for a time permanently interrupted, points to stone or other foreign body in the urethra; a stream becoming slowly smaller and less forcible, and ultimately dropping directly down from the end of the penis, points to enlargement of the prostate or to urethral stricture placed far back; it also may be due to acute congestion, chronic prostatitis, atony of the bladder, tumor-formation, or extra-urethral pressure.

A stream which has become gradually small and lacking in force, and which is suddenly arrested, may be due to congested stricture, congested enlarged prostate, or impacted stone.

A fairly forcible stream which is intermittently and irregularly stopped for a moment at a time—the so-called "stuttering urination"—is due to vesical spasm, and is either a neurosis or a reflex.

Suppression of urine indicates failure of excretion from the renal tubules. It must be distinguished from retention of urine in the lower urinary tract, though such retention may occasion suppression.

The causes of suppression: 1. Non-obstructive. 2. Obstructive.

NON-OBSTRUCTIVE SUPPRESSION develops in crippled kidneys secondary to trauma—even when trifling—of the genito-urinary tract. It may follow severe systemic injury and is an occasional post-opera complication. It is partly reflex, partly toxic, as in the case of ex sive burns of the skin, and may be brought about by the passive gestion incident to extreme cardiac weakness.

The symptoms of non-obstructive suppression, aside from failure to pass water or to present the evidences of fluid retaine the bladder or renal pelves, are those of uræmia.

Obstructive suppression is that associated with blocking of ureters or of the vesical outlet.

The symptoms of obstructive anuria may be veiled by an acc panying retention, but failure of further excretion on relieving retention, and the later development of uræmic symptoms will s ciently mark the diagnosis.

Treatment.—After operations on the genito-urinary organs, diuresis should be secured, and for this purpose the free inges of water, enteroclysis, and hypodermoclysis of normal salt solu are beneficial. Circulatory depression is benefited by strych digitalis, and particularly by nitroglycerin, the relaxing effect of latter being distinctly useful. In all cases, active elimination sh be secured by hot packs, vapor baths, in some cases by pilocarpin podermically, and by free purgation by calomel and the saline cat tics. In the common form of suppression due to reflex sympat causes, hot poultices, cupping, and other counter-irritants are us and it is here that high hot injections of salt solution into the c are doubly indicated. If shock be the cause, adrenalin chloride in venously with strychnine and atropine hypodermically are indicat

The various operative procedures which have been beneficia suppression *per se*, aside from those directed to its cause, are si puncture, splitting the capsule, incisions into the capsule, decap tion, and nephrotomy. These operations (described elsewhere) sh not be done until other measures have failed, nor should they be poned until the patient becomes apparently moribund, though then they have been successful. Operative measures are indic if three days of conservative treatment have proven futile, th cases cured after eight days are reported. A local cause, suc a blocking calculus, should be suspected in the absence of a prece history of chronic renal degeneration.

Retention of Urine.—Retention implies inability to empty bladder. This may be due to atony or paralysis of the detr muscles, to reflex spasmodic action of the sphincters, or to obst tion at the neck of the bladder or in the urethra.

Locomotor ataxia, Pott's disease, general palsies, sclerosis, severe cerebro-spinal injuries may, by interference with the vesical centre of the cord, occasion paralytic retention. The muscles may be directly paralyzed by over-distention, by inflammation extending from the mucous coat or from the peritoneal investment, as in peritonitis, or as the result of degeneration consequent upon prolonged exhausting diseases.

Spasmodic retention may follow shock or injury, operations upon the spermatic cord, the rectum, or the testicles, or prolonged voluntary retention. Obstruction at the vesical orifice may be due to tumor, impacted stone, clot, foreign body, or prostatic hypertrophy.

Retention may be of sudden or of gradual onset, and may be partial or complete.

The retention of sudden onset is typified by that observed in cases of rupture of the urethra, or of impacted stone, or of reflex spasm following operations on the anus. The symptoms are pains felt in the region of the bladder and steadily increasing in intensity, recurrent unavailing efforts at micturition with a constant torturing desire, extreme tenderness over the region of the bladder, and the formation of a distinct tumor, dull on percussion, globular in shape, and sometimes extending as high as the umbilicus. Rectal and suprapubic palpation show that this tumor is fluctuating, and that it occupies the position of the distended bladder. The final proof is afforded by catheterization.

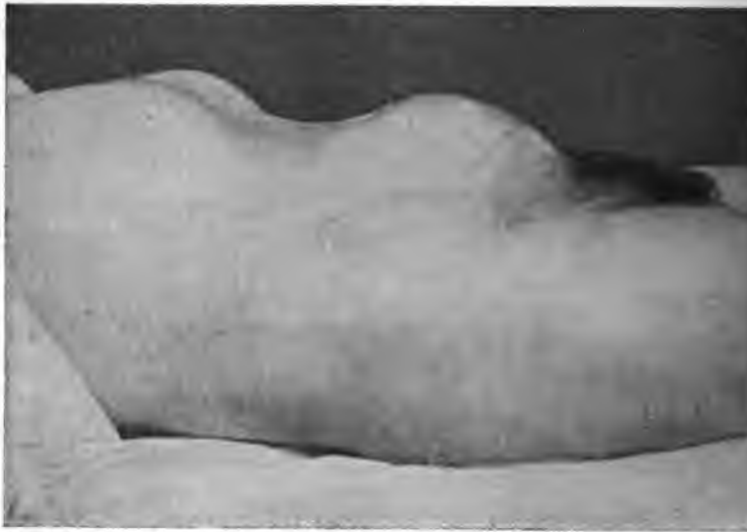
Gradual retention may develop so insidiously that it is not suspected until direct examination shows the presence of bladder-distention. Urethral stricture, lesions of the cord, intracystic and extracystic bladder-growths or inflammations, enlargement of the prostate, and atrophy of the detrusor muscles are common causes of this form of retention. The early symptom is frequent micturition, the stream passing with little force and often with much diminished volume. This frequency is due to the fact that the bladder is unable to empty itself entirely, a certain amount of residual urine remaining.

Even when the vesical muscles are healthy, if the flow of urine is so obstructed that the time required to empty the bladder is unduly prolonged, the involuntary detrusor muscles, becoming tired, relax before the bladder is thoroughly empty, thus allowing a certain amount of residual urine. This residual urine is proportionate in quantity to the degree of obstruction encountered in the urethra and to the loss of tone of the bladder-muscles. When sterile and moderate in amount the only symptom it causes is increased frequency of urination. The reason for this is obvious: if the bladder cannot hold more than ten ounces comfortably, and if, when it is full, an unsuccessful effort is made to empty it, five ounces remai the desire to urinate will again occur when five more ounces been secreted by the kidneys, since the bladder will then co ten ounces. Its capacity as a receiver of urine from the kidne lessened proportionately to the amount of residual urine it conta

When the retained urine exceeds four to six ounces, becau the frequent urinations and the more or less sustained tension, develops a certain degree of chronic congestion of the bladder, w is often markedly increased by cystitis and fermentation of the nant urine.

As the obstruction gradually increases, and as the muscles be atonic or atrophic from congestion, inflammation, and overstretc

FIG. 100.



Tumor formed by the distended bladder. Gradual distention from hypertrophied prostate

the bladder is more and more dilated, until, finally, it may r enormous proportions. When this gradual retention occurs in course of fevers,—typhoid, for instance,—it is probably due to generation of the detrusor muscles and to abolition of the no reflex. The bladder may then slowly distend, giving rise to symptoms other than apparent incontinence, the sphincter m yielding when the intravesical tension becomes sufficiently high allowing the urine to trickle slowly away. The same gradual un pected distention develops in chronic prostatic overgrowth, the sy toms suggesting incontinence rather than retention, and the condition not being suspected till inspection or palpation sho hypogastric tumor. The appearance of this tumor is seen in Fig. 100. The patient from whom this photograph was taken complained of urinary incontinence, and was brought by his physician because of a supposed solid growth in the hypogastric region. Bimanual palpation at once proved that this mass was the distended bladder.

When associated with fevers, and, indeed, under all circumstances, incontinence of urine should lead to careful examination for an over-distended bladder.

When the bladder is able to empty itself partially, the retention is incomplete. When no urine can be passed, it is complete. In either case there results an abnormal intravesical tension, intermittent when the function of micturition is not entirely suppressed, continuous and steadily increasing in case of complete retention.

THE EFFECTS OF RETENTION.—Guyon and Albarran have shown experimentally that even a moderate amount of retention causes distinct vesical congestion, followed, if the retention is not relieved, by ecchymoses, bloody extravasation, involving the whole thickness of the bladder-walls, and pronounced epithelial desquamation. The ureters and the kidney pelves and tubules show the same changes, —*i.e.*, intense congestion and parenchymatous ecchymoses and epithelial degeneration and shedding. The peritoneum overlying the bladder is often congested and ecchymotic, and the intestines and abdominal viscera participate in the general vascular engorgement. Ultimately the bladder ruptures into the peritoneal cavity.

As a result of over-distention the detrusor muscles of the bladder are paralyzed, remaining absolutely flaccid, even though the urine be drawn. The desquamation of the stratified pavement epithelium, which when normal and unbroken prevents absorption from the bladder, exposes the lymph- and blood-channels, thus allowing toxic substances and micro-organisms contained in the urine to poison the system. When the vesical tension is very pronounced, the downward current of urine passing from the kidneys to the bladder ceases, and, if there is concomitant infection, this will rapidly reach the kidney pelvis by way of the ureter, though reversed peristalsis or backward regurgitation as the result of vesical tension has not been shown experimentally. Ultimately the sphincter muscle at the vesical orifice of the ureter becomes insufficient, since even inert bodies, such as powdered charcoal, will, if injected into the bladder, ascend in small quantities into the kidney pelves.

Death results from uræmia; very exceptionally in men from rupture. The temperature in the absence of infection is normal or subnormal. The extent and severity of the lesions just described are dependent on the degree of vesical distention, and this in turn is portionate to the duration of the complete retention and the quan of urine secreted.

As a result of experimental research and clinical study, the mediate effects of extreme acute distention of the bladder may summarized as follows. The bladder, prostate, ureters, and kidn are enormously congested. The muscles of the bladder become sufficient, and their fasciculi are often mechanically separated the distention, producing the ribbed or trabeculated bladder. kidneys, at first excited to increased activity, as pressure increa secrete slowly or not at all. The whole urinary tract is ripe infection, and absorption from this tract takes place readily.

If micro-organisms are introduced into the bladder they rapidly produce cystitis and quickly reach the kidneys. The in duction of similar organisms into the healthy bladder is without effect, since the flat epithelium prevents their entrance into the sues, and the intermittent stream of water from the ureters ke them from ascending along these channels.

Chronic retention produces pathological alterations which are immediately threatening than those of acute retention. There chronic congestion of the entire urinary apparatus, with pronoun susceptibility to infection. When the retention is moderate and complete these changes are limited solely to the bladder, since ureters and kidneys are reached only when vesical tension has b extreme.

The first effect of increased vesical tension on the kidneys is marked increase in secretion, due in part to bladder irritation, pr ably in the main to congestion. Later the urine is diminished quantity. Exceptionally, after relief of tension, anuria develops ; m frequently there is pronounced polyuria.

The fever, if it develops, is nearly always due to concomitant fection, and not to retention itself. The temperature is normal subnormal in both acute and chronic retention.

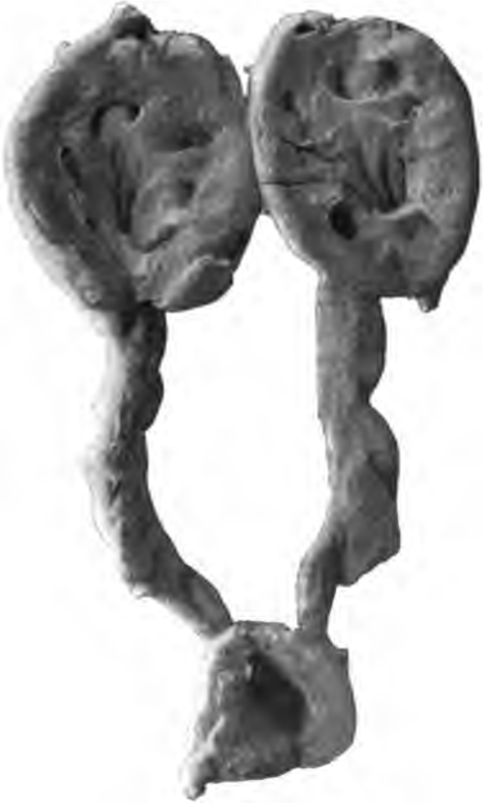
Although the immediate effects of chronic retention, the use of term chronic necessarily implying that the retention is incomplete, less serious than those of acute retention, the ultimate results equally disastrous, the bladder dilating and losing tonicity, and ureters, kidney pelves, and kidneys becoming involved.

The bladder muscle may be completely and permanently pa lyzed, or, where the retention is partial, particularly in case stricture, it may be greatly hypertrophied. This hypertrophy none the less followed by dilatation of the ureters and their pel and profound alterations in the structure of the kidneys. (Fig. 101.)

The general treatment of acute and of chronic retention calls for relief of tension as soon as possible, and the observance of rigorous antiseptic precautions in the use of the catheter. Sudden evacuation of the bladder in cases of chronic retention often occasions bleeding not only from the bladder, but also from the kidneys and into the substance of these organs. This is less liable to occur when the urine of acute retention is drawn. It is due to the rapid diminution of pressure to which engorged vessels have long become accustomed. The renal congestion is often evinced by blood-casts.

Exceptionally, after the first evacuation there may be such marked relief of congestion that the power of micturition is restored. Usually catheterization must be employed for some time. Where there is polyuria—and this is frequently the case—it is important to catheterize the bladder frequently. This manipulation may have to be repeated every two hours. The intervals should be such that not more than eight to twelve ounces shall accumulate before being drawn.

Fig. 101.



Hypertrophied bladder from urethral stricture. Dilatation of ureters and kidney pelves.

From an etiological stand-point retention of urine may be classified as follows:

1. Retention due to paresis or incöordination of the bladder muscles.
2. Retention from congestion or acute inflammation.
3. Retention due to blocking of the urethra by clots, foreign body, stone, or portions of new growth.

4. Retention caused by prostatic enlargement.
5. Retention caused by stricture.
6. Retention due to traumatism.

1. Retention of Urine due to Paresis or Incoördination of Bladder Muscles.—Under this heading are classed those cases which narrowing or pathological alteration of the channel of exit the urine plays no part. There is no preceding history suggest urethral stricture or prostatic enlargement. The cause of retentio either failure of detrusor power or loss of control over the sphinct these not relaxing as they normally should when the detrusors c tract. This form of retention is common in cerebral injury, in he plegia, in paraplegia, in spinal injury or disease, in Pott's disease, in spinal ataxias. In ataxic cases the retention may be from sens failure, the patient not perceiving when the bladder is full; a cath must then be used not according to a feeling of vesical repletion, at certain definite times.

The retention sometimes observed in shock, hysteria, periton paravesical inflammation, exhausting diseases, neurasthenia, and untary postponement of the act of micturition may be partly sp modic, but is probably due in the main to muscular atony and ordered reflex action. Retention following operations about the a or complicating a full rectum is usually spasmodic, the sphin being excited to undue irritability not only by the nervous reflex, also by the vascular engorgement consequent on these operations.

Symptoms.—Retention, whatever be its cause, is characterized the same symptom,—*i.e.*, the formation of a fluctuating tumor in bladder region. In cases of paraplegia or abolition of sensibility pain and frequent efforts at urination are wanting. Under other cumstances, if the retention has been of sudden onset, the distres occasions is characteristic and unmistakable. Since the urethr patulous, there develops, usually before there is much back press exerted in the direction of the kidneys, a dribbling of urine, the continence of retention, which is misleading. A patient who co plains of incontinence should always be examined for retention.

Diagnosis.—The probable absence of urethral or prostatic struction will be founded on the patient's previous history, or, if is unobtainable, urethral exploration will show that the way to bladder is unobstructed. Spasm of the compressor urethræ n be misleading, but this yields completely to the gentle steady press of a steel sound.

When retention develops without apparent cause in a per who gives no previous history of urethral or bladder trouble, neuropathies must be suspected, and search should be made for corroborative signs of ataxia.

Treatment.—Retention which is a local expression of hysteria or neurasthenia is usually relieved promptly by a hot-water enema (103° F.), followed by a hot sitz-bath or general bath. The patient is directed to pass the enema while still in the bath, and usually will urinate without difficulty during the act of defecation. This treatment is efficient in retention from constipation, anal operations, inflammation, shock, or prolonged voluntary retention.

When the hot enema and bath fail, or if these cannot be applied, catheterization is indicated. This must be practised with precisely the same care as would be exercised by the surgeon were he about to perform a major operation, since it has been shown that, from the intense congestion which always accompanies retention, the bladder is peculiarly vulnerable to sepsis and the kidneys are ripe for an ascending infection.

The evacuating instrument, preferably a soft rubber catheter, about No. 16 F., is lubricated, introduced as far as the membranous urethra, and attached to an irrigating-bag containing a hot dilute antiseptic solution (1 to 20,000 bichloride). A half-pint of this solution is allowed to flow through the catheter, thoroughly irrigating the anterior urethra: the irrigating-bag is then disconnected, and the catheter is passed into the bladder.

When retention has been chronic and progressive, and particularly when there is also infection, the sudden emptying of the bladder is liable to be followed by severe hemorrhage, which, involving the kidneys and their pelves, may result in partial or complete suppression of urine and may prove fatal.

When retention is due to a central nerve lesion, as in Pott's disease, trauma, or ataxia, or to muscular degeneration, as in typhoid fever or in arteriosclerosis, regular aseptic catheterization must be practised as frequently as is required to prevent abnormal vesical tension. If at any time more than twelve ounces are drawn, this indicates that the intervals between instrumentation are too long. Practised with due attention to cleanliness, these catheterizations prevent cystitis, since they relieve the venous engorgement, which is the most potent predisposing factor to infection.

In all these cases urinary antiseptics should be administered by the mouth, and careful attention should be given to the diet and to general hygiene.

2. Retention of Urine from Congestion or Acute Inflammation.—When, as the result of a severe gonorrhœa, an irritating injection,

rough sounding, or a prostatic abscess, retention develops, this be due partly to blocking of the urethra by inflammatory swell partly to spasm. In the vast majority of cases neither spasm acute urethritis is competent to cause complete retention. When develops there is usually a pre-existing lesion, such as stricture of l calibre, chronic prostatitis with sclerosis and contracture of the ternal vesical sphincter, or moderate prostatic enlargement, not s ciently obstructive in the absence of acute inflammation to cause e partial retention.

Symptoms.—Aside from the characteristic symptoms of retent the determination of the cause of this condition will depend in main upon the preceding history. If symptoms of enlarged pros or of long-standing gleet are absent, and if in the course of an a gonorrhœa, for instance, retention develops, the cause of this mus looked for either in the urethra—usually in its membranous pa or in the prostate. Before exploring the urethra the prostate sh be palpated per rectum; if this is normal in size and non-sensi urethral inflammation and spasm may be suspected as the cause retention. In this case the hot bath and hot enema are indica since instrumentation should be avoided because of the danger of fecting the bladder. If these measures, reinforced by opium supp tories or morphine injections, prove useless, a woven coudé cath should be passed, since the urethral spasm is so tight that it effecti resists the softer instrument. This causes such agonizing pain th is well to administer ether to the first stage each time it is used. should be preceded by urethral irrigation, and should be withdr while an antiseptic solution is flowing through it.

When the prostate felt through the rectum is large, hot, tender, recourse may be had to hot baths, enemas, and opium, there is little hope of relieving vesical tension by these means un the swelling is purely congestive. In that case it should sub promptly under treatment, and palliative measures should be effici Should they fail, the catheter must be used without delay, not for immediate relief, but also because by regularly emptying bladder this viscus is less likely to become infected. The prost abscess should be opened as soon as it is detected, preferably thro the perineum.

3. Retention of Urine from Sudden Blocking of the Urethra the Vesical Neck.—This form of retention may be due to the lod ment of a stone or foreign body in the urethra, to a peduncula bladder-tumor situated near the neck of the bladder and acting ball-valve, or to blood-clots sufficiently firm to plug the vesical orif

Urethral calculi and foreign bodies have been considered in another part of this work.

Blood-clots rarely cause retention when the urethra is unobstructed. They are liable to cause intermittent blocking of the urethra, but are ultimately expelled. In cases of prostatic hypertrophy or stricture, clots may cause absolute retention and may seriously interfere with catheterization.

Symptoms.—Retention of urine from vesical clots will give no characteristic symptoms other than those of sudden retention. Bloody urine containing small clots may have been passed before the retention develops. There is a history of previous hemorrhage, or there is a sufficient cause, such as traumatism, for extravasation of blood. The catheter enters the bladder readily, and, even though it is almost immediately blocked by a clot, draws some bloody urine; suction by a syringe draws out fragments of clot and allows the urine to flow.

When the retention is due to a pedunculated tumor or a small movable calculus, the symptoms may be precisely the same as those which characterize retention from clot, since there are likely to be hæmaturia and sudden stoppage of the stream of urine. If, however, the catheter is passed well within the bladder, its eye is not blocked and the urine flows freely.

Diagnosis.—In deciding whether retention is due to blood-clot, small, movable stone, or pedunculated tumor, the history of the case and the course of the symptoms will usually lead to a correct opinion. Thus, stone is preceded by renal colic, by frequency of urination, and by pain felt just behind the meatus at the end of the act. When it is displaced from the neck of the bladder by a metal catheter a characteristic grating may be felt. The urine which is drawn contains but little blood.

A pedunculated vesical tumor may cause an obstruction which readily yields to the catheter and which bleeds freely. The nature of the obstruction would be open to suspicion if, in the absence of symptoms of stone, the patient complained of occasional apparently causeless profuse hæmaturia; if on the relief of retention no clots were drawn, the urine flowing freely as soon as the eye of the catheter reached the bladder; and if urination in the dorsal decubitus prevented the stoppage of the stream. Finally, cystoscopic examination should definitely settle the matter.

Treatment.—Retention from blood-clot does not necessarily call for immediate catheterization, since, provided there is no urethral obstruction, as the clot softens and disintegrates it is passed spontaneously; indeed, it is more likely to escape through the natural pas-

sage than through a medium-sized catheter. A hot bath and
opium suppository or a morphine injection to relieve the associ
spasm of the sphincters, and efforts at urination made with the
tient in the dorsal decubitus and with the pelvis elevated, us
result in relief.

Should these measures fail, the patient is placed on his back
the pelvis elevated, and a large woven catheter is passed till its e
just within the internal vesical sphincter. This decubitus fa
gravitation of the clots to the upper posterior portion of the blad
where they are less likely to block the catheter before the main
of the urine has been drawn off.

When the catheter becomes obstructed from lodgement of a cl
its eye, a drachm of dilute antiseptic solution should be injected
bly. If after several repetitions of this manœuvre it is apparent
the catheter cannot be kept clear long enough to allow the uri
flow in sufficient quantity to relieve tension, an eight-ounce
rubber syringe, with a piston which fits accurately, should b
tached to the end of the catheter and the clots should be sucked
Should this method fail, a large evacuating litholapaxy-tube sl
be passed, and through it the blood should be aspirated.

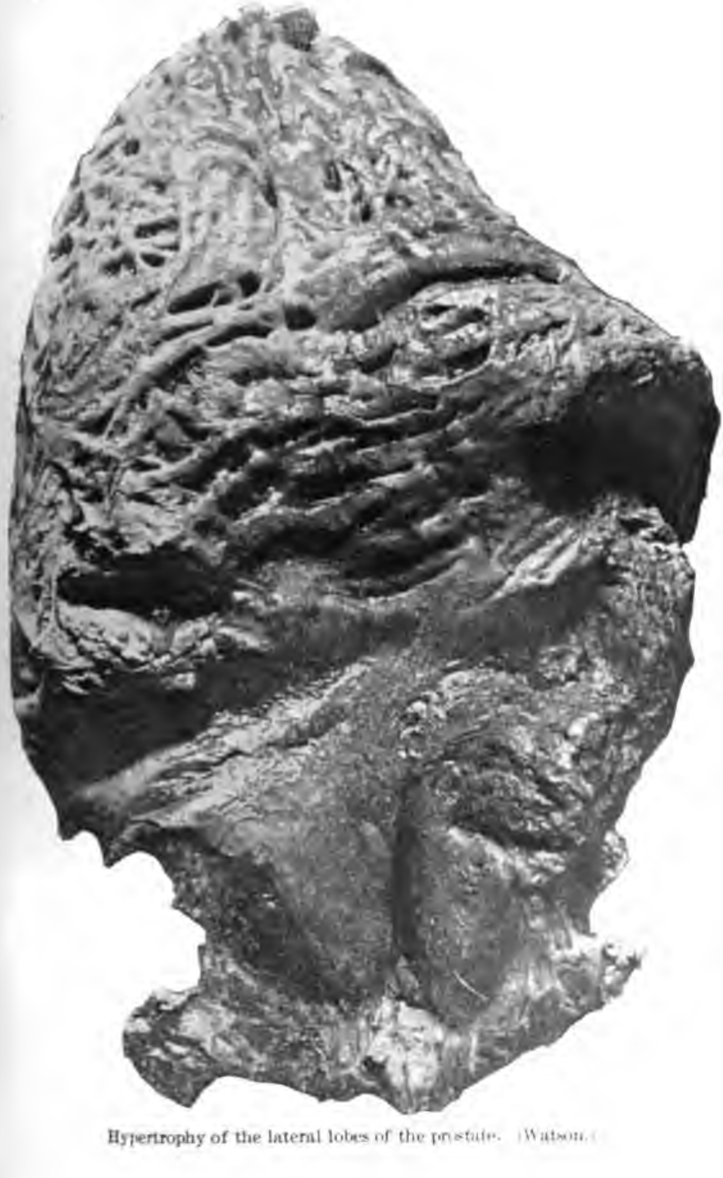
If because of a large prostate the evacuating tube cannot be pa
either perineal or suprapubic cystotomy is indicated, in accord
with the cause of the bleeding. In any event the retention mu
relieved and the bladder freed of clots, since the presence of
in the urine markedly favors the development of cystitis. Emp
the bladder is the most efficient means of stopping further ble
if this is of cystic origin.

Retention due to a pedunculated cystic tumor can be relieve
catheterization, the instrument pushing aside the growth and pre
ing it from acting as a plug. The same treatment is appropria
calculus lodged in the vesical neck.

RETENTION OF URINE FROM PROSTATIC ENLARGEMENT.

Of all forms of urinary retention that due to hypertrophied
tate is the most frequent. This complication of hypertroph
infinitely more serious than the disease which causes it. It is d
the increased resistance to the escape of urine offered by alteratio
the bladder-neck, elongation and deflection of the prostatic ur
diminution in the calibre of the latter, and vesical atony. The
of the vesical orifice are thickened, and the opening is raised abov
level of the bas-fond, thus leaving a pouch. The overgrowth ma
volve one or all of the prostatic lobes; usually the entire prost

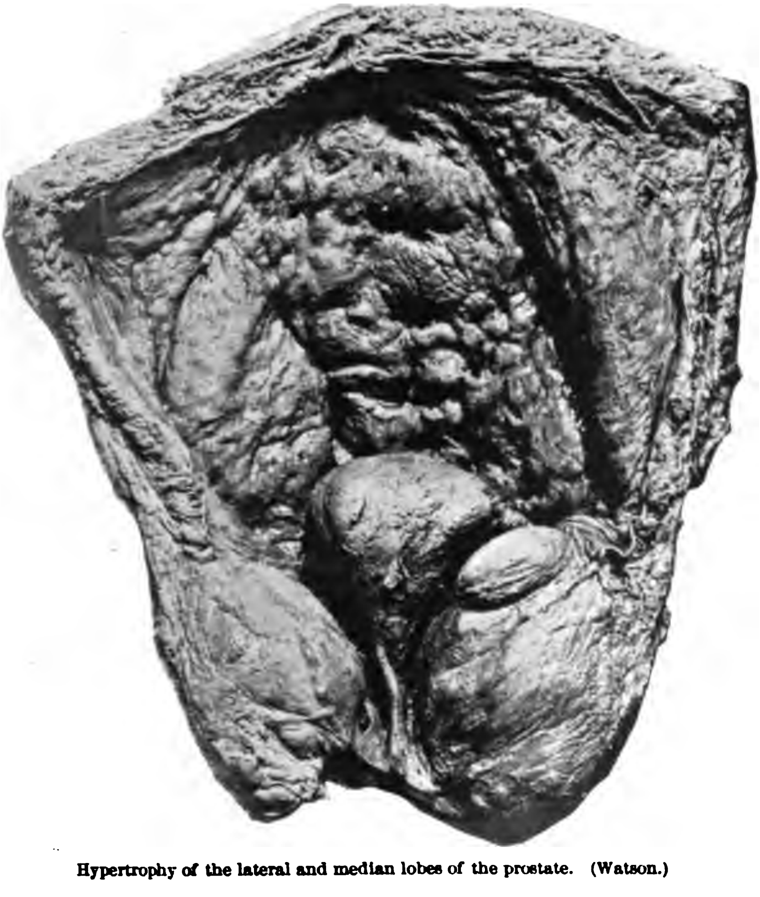
FIG. 103.



Hypertrophy of the lateral lobes of the prostate. (Watson.)

enlarged. (Fig. 102.) From overgrowth of the middle lobe more or less of a projection is formed at the vesical orifice. The enlarged lateral lobes narrow the urethra and force it to one side or the other, in accordance with the position of greatest overgrowth. (Fig. 103.) As a result of this obstruction the bladder-muscles become weakened, at least so far as their propulsive power is concerned. There is

FIG. 102.



Hypertrophy of the lateral and median lobes of the prostate. (Watson.)

always very marked hypertrophy of individual fibres or fasciculi, forming prominent ridges. The general symmetrical hypertrophy so frequently observed in partial retention following stricture is rarely found when obstruction is due to prostatic hypertrophy. Vesical inertia is also encouraged by muscular degeneration incident to atheroma, which so often complicates enlarged prostate, cystitis, prolonged venous congestion, and over-distention.

As a result of overgrowth the prostatic urethra may be do or even triple its normal length. The vesical orifice and pros urethra are encroached upon at the expense of the lower and lat walls. The superior wall preserves its normal direction. This is important as bearing upon the proper use of catheters for relief of retention.

The prostate may be tough and fibrous, presenting an obst which will yield only to rigid instruments, or may be so friable th is bruised and lacerated by even soft rubber catheters or explo bougies. Its dimensions as felt by the rectum do not necess indicate the degree of urethral obstruction it occasions.

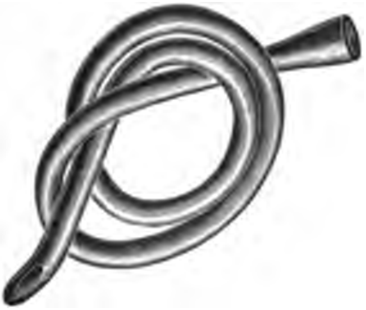
Symptoms.—During the earliest stages of prostatic enlargemen symptoms are excited upon the part of the bladder; as the gro increases, elevating the internal vesical orifice, there is partial re tion, a certain amount of residual urine remaining after each mic tion. This, if it is sterile and does not exceed four to six our causes no symptoms other than a slight increase in frequency urination and a habit of rising once in the early morning hour empty the bladder.

As the obstruction becomes more pronounced, residual urine creases in amount, the desire to urinate comes more frequently is more imperative, especially at night, there is usually slownes starting the stream, and this is projected with less force. Fin there is distinct vesical atony, the walls of the bladder yield to slowly increasing tension, and that viscus becomes greatly dila sometimes extending above the umbilicus. This dilatation invo the ureters and the kidney pelves. The secreting portion of kidney becomes insufficient, a condition of uræmia develops, c acterized by gastro-intestinal disorders and steady deterioratio health, and death ensues. When the bladder reaches an extr degree of distention there is a constant dribbling of urine. It shoul noted that this train of pathological changes may be evolved wit the patient having the faintest conception that there is a conditio vesical tension, the symptoms of which he complains being sir frequent micturition, especially aggravated at night, often attrib to polyuria, and ultimately followed by incontinence of urine, culty in starting the stream and loss in its force, and appare causeless digestive troubles. Should cystitis intervene, the ve symptoms become so marked that they will scarcely be overloo There are then pain, tenesmus, and all the phenomena of blad inflammation aggravated by the retention.

If, in the course of chronic incomplete retention, the enla prostate becomes suddenly congested from infection, exposure, sexual excesses, indiscretion in diet, or other sufficient cause, there will result acute retention, characterized by restlessness, pain in the bladder, and futile efforts at micturition. This acute retention is often not complete, the patient being able to pass a portion of his water, but only after violent straining.

Diagnosis.—Retention due to prostatic enlargement is observed in men past middle age. There is a history of frequent urination, beginning with night rising and slowly becoming more marked. Until an extreme degree of tension is reached, this frequency is always most marked in the night or early morning. Rectal examination shows an enlarged prostate, and rectal and suprapubic palpation demonstrate a full bladder. On passing the catheter immediately after voluntary micturition, residual urine is drawn and the urethra is found to be abnormally long. To measure the urethral length, the catheter is introduced till the water begins to flow; its shaft is then pinched with the thumb at the point corresponding to the meatus. The urethral length is determined by withdrawing the catheter and measuring the distance from the thumb to the eye of the instrument. Normally this should be about eight inches.

FIG. 104.



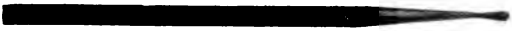
Soft rubber catheter.

Retention from chronic prostatitis accompanied by contraction and sclerosis of the internal vesical sphincter gives the same picture, except that the urethra is not lengthened. Rectal palpation shows a small, hard prostate, and cystoscopic examination fails to demonstrate nodular projections at the vesico-urethral junction.

Treatment.—Complete retention from prostatic enlargement always requires prompt mechanical or surgical intervention. The time spent in palliative measures is wasted, and may give an opportunity for the development of irremediable lesions. With very few exceptions, it is possible to pass an instrument into the bladder. The surgeon should be provided with soft, straight, and elbowed rubber catheters, each having a large sunken eye, a solid tip, and a funnel end (Fig. 104), flexible woven olivary (Fig. 105) or conical catheters (Fig. 106), woven catheters, single and double elbowed (Figs. 107, 108), stiff English cylindrical catheters (Fig. 109), and one or two long full-curved silver prostatic catheters (Fig. 110), calibre 18 to 20 F., twelve

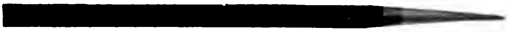
inches in length, and with an unusually long curve. The c
of the soft instruments should be from 14 to 18 F. An irri
apparatus, provided with a conical glass nozzle which can be
into the ends of the catheters, a sterile lubricant, and a suf
number of sterile towels, also must be provided.

Fig. 105.



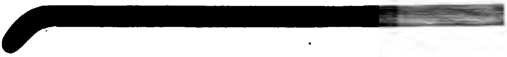
Olivary catheter.

Fig. 106.



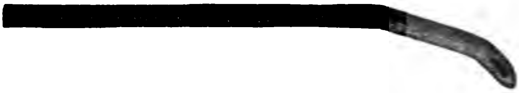
Conical catheter.

Fig. 107.



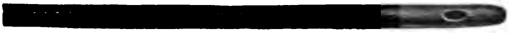
Elbowed catheter.

Fig. 108.



Double-elbowed catheter.

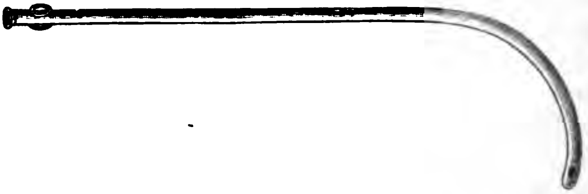
Fig. 109.



Cylindrical catheter.

If the history of a case suggests the possibility of stricture co
cating enlarged prostate, the soft, flexible, bulbous, or olivary bo
will be required. A preliminary rectal examination having
made, the urethra thoroughly flushed out, and the penis and

Fig. 110.



Silver prostatic catheter.

cleansed as for an operation, a slit is cut in a sterile towel, and thr
this the penis is slipped; thus the manipulative area is surrou
by a sterile surface. The surgeon, having sterilized his hands,

cates a sterilized soft elbowed catheter of medium size, passes it to the compressor urethræ muscle, attaches its free end to the irrigator, and washes out the anterior urethra; he then endeavors to pass the instrument into the bladder. When gently repeated efforts, continued for one or two minutes at most, fail, the rubber catheter should be attached to the irrigator, and should be withdrawn while a dilute antiseptic solution (four per cent. boric acid) is flowing through it. A woven catheter (coudé) is then tried. The slight angle at the end of this instrument is of service, partly because it enables it readily to override obstacles, and partly from the fact that the bend keeps the extremity of the instrument applied to the upper urethral wall. It will be remembered that the obstruction is found mainly in the lower and lateral walls of the urethra, the upper portion remaining comparatively normal. Hence, if the end of the instrument is kept constantly in close contact with this normal surface, it can be readily guided into the bladder. The tip of the elbowed catheter must, therefore, be kept against the urethral roof.

Should the elbowed catheter fail to gain an entrance, the double elbowed or bi-coudé catheter may be tried.

In the event of this failing, a soft rubber catheter of small calibre, No. 10 to No. 12 F., is slipped on one of the iron wire stylets with which English catheters are provided. The extremity of this stylet stops one inch short of the eye of the catheter. To the soft rubber catheter, thus made rigid but with a perfectly flexible end, a long curve is given by bending the wire. This corresponds in general with that of the prostatic silver catheter. This long curve keeps the tip of the instrument apposed to the urethral roof and thus guides it into the bladder. The rigidity imparted by the stylet enables enough pressure to be applied to overcome any resistance offered by the close apposition of tough fibrous walls, and the flexible end readily finds its way over or around abrupt projections. All these manipulations must be conducted with the utmost gentleness, yet the most skilful manipulation will occasion bleeding because of the intense congestion which always accompanies retention.

Should the soft catheter threaded on the stylet fail to pass, the long prostatic silver catheter may be used. In passing the catheter it must be borne in mind that the urethra is always lengthened, sometimes two or three inches, and that the bladder may not be reached because of failure on the part of the surgeon to pass his instrument far enough. Sometimes a long flexible rubber or whalebone guide can be made to pass the obstruction, and a tunnelled catheter can be passed over it, as in cases of stricture, although this procedure is not

so uniformly useful in cases of prostatic retention. Should g
efforts with all these instruments, continued not more than tw
three minutes for each, result in failure to reach the bladder, su
pubic aspiration is indicated.

A method of treatment attended with more immediate risk
aspiration, but which has given satisfactory results where there i
hope of relief by catheterization, is suprapubic puncture by mea
a curved trocar and canula.

In cases of retention from prostatic enlargement uncompli
by infection, and particularly when there have been no previous
attempts at instrumentation, the soft rubber catheter or the fle
woven elbowed catheter usually enters the bladder without diffi
When this end is accomplished the surgeon's serious responsi
practically begins. If as a result of long-standing vesical tension t
has been dilatation of the ureters or of the kidney pelves, with ma
alterations in the kidney structure, and particularly if there has
previous infection, or if this is carried in by instrumentation, su
evacuation of urine may be followed by suppression, uræmia,
death, occurring in either a few days or a few weeks. When
kidneys are comparatively healthy, sudden complete evacuatio
the bladder-contents, by interfering with the conditions of pres
to which the blood-vessels have become accustomed, may occa
severe hemorrhage not only in the bladder but in the kidneys th
selves. This, even when slight in degree, by favoring the deve
ment of cystitis, may constitute a grave complication. If profu
becomes serious, not only because of its systemic effect, but
because by clotting and obstructing the catheter it interferes with
flow of the urine. To avoid bleeding the urine should be drawn
slowly, with the patient in a recumbent position. Except when
distention is slight and of short duration, the bladder should n
be completely emptied at the time of the first catheterization. W
the urine is clear and sterile, about half the bladder-contents sh
be allowed to remain. When there is blood or pus in the urin
of this should be drawn from the bladder, but without allowing
viscus to be entirely empty at any time. This end is attained in
following way: Before passing the catheter the bladder is palpate
enable the surgeon roughly to determine the amount of tension.
catheter is introduced and somewhat more than half the reta
urine is drawn. This may be two to three pints. Eight to tw
ounces of a warm sterile four per cent. solution of boric acid are
injected into the bladder by means of the irrigator and immediately
same quantity of mixed boric acid solution and urine is allowe

escape. This partial filling and emptying of the bladder is continued till the blood and pus disappear and the liquid evacuated has the colorless appearance of the boric acid solution. The catheter is then slowly withdrawn, with the boric acid solution still flowing through it.

The immediate dangers of tension having been thus removed, the subsequent treatment of the bladder must be clearly formulated.

The invariable rule of treatment in these cases should be regular evacuation of the bladder, the number of catheterizations required daily being regulated by the activity of the kidneys. Four to eight times in twenty-four hours are usually sufficient. Each time enough urine is withdrawn to lessen distinctly the residual amount. This residuum is then replaced by boric acid. By the end of a week the bladder can usually be completely emptied without fear of ill results.

Even after the bladder begins to recover its tone and the patient regains some power of passing his water, he should be cautioned against throwing aside his catheter so long as his efforts at micturition are painful and are attended with much straining and with a feeble and insufficient flow of urine. Continuance of catheterization is particularly to be insisted on when there is cystitis, since the abortive straining efforts at urination markedly increase local congestion.

If the urine has remained sterile, and if the patient has regained the power of passing the greater part of his water with comparatively little effort, it is then safe to discard the catheter, since a moderate quantity of sterile residual urine is hurtful only so far as it lessens bladder-capacity.

When the passage of a soft instrument is difficult, is extremely painful, and is attended with much bleeding, and this is particularly the case when there have been previous unsuccessful attempts at catheterization, and when there is cystitis with purulent, often ammoniacal, urine, the objects for which the instrument is used—*i.e.*, efficient bladder-drainage and relief of local congestion—cannot be attained, since frequent passage of the instrument is impracticable. Under these circumstances continuous catheterization is serviceable. When retention is complicated by fever, continuous catheterization finds its most useful application.

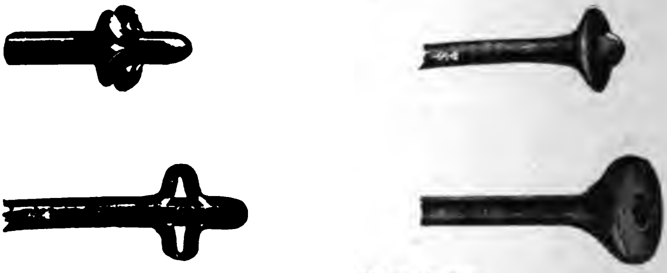
Even in cases of bleeding from vesical tumor with infected bladder, from the time of insertion of the permanent catheter defervescence is rapid and blood disappears, doubtless owing to the physiological rest given to the bladder-walls. In the same way bladder-pain is relieved.

When in the course of intermittent catheterization the introduction of the instrument becomes difficult, it is well to advise patients to practise for some hours or days permanent catheterization ; the effec the instrument thus used is to cause softening and dilatation of urethra, allowing an easy passage of the catheter. This perma catheter does not lessen prostatic enlargement ; it simply relieves gestion by providing for free drainage.

When pain is caused, this is due to improper application of method. During the first hours exceptionally there is a sens weight and inconvenience. This quickly subsides, and the c eter may then often be continued for weeks without causing suffering.

The soft rubber instruments are best suited to permanent cath ization. If a woven catheter is employed, this should be thin-wa of as large calibre as possible, and provided with two large tern eyes. They are placed in the turned-up portion, and hence not l to be occluded by the bladder-walls.

Fig. 111.

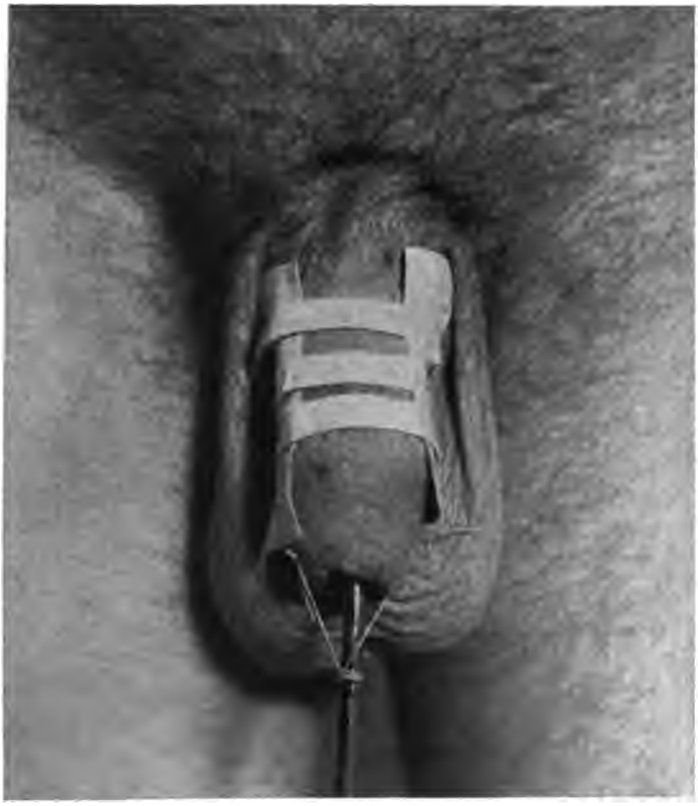


Soft rubber self-retaining catheters.

The self-retaining catheter is also useful. (Fig. 111.) This soft rubber, 18 to 22 F., and is provided with lateral terminal pr tions, which disappear when it is drawn tightly over the metal ca It is thus introduced ; the carrier is then withdrawn, and the elas of the instrument causes the projections to reappear. The surge enabled to determine how far the tip of the instrument is passed the bladder by gently drawing the catheter out until he feels the r ance caused by these rubber projections when the narrowing o vesical neck is reached. When this resistance is felt, it is ce that the catheter eye lies just within the grasp of the internal ve sphincter. If the elbowed catheter is used, the exact depth at whi must be maintained is determined by gently withdrawing it whe contents of the bladder are almost evacuated and noting the mo when the stream ceases to flow. It is then passed in again unti stream begins to flow, and is fixed at this point.

To determine positively that the instrument is properly placed and completely evacuates the bladder, after the stream has ceased to flow sudden pressure is made in the hypogastric region. If the bladder is empty there will be no jet of urine. Next a definite quantity of antiseptic solution is injected into the bladder; all of it should be returned immediately. Next the end of the catheter should be watched, to see that the urine drops steadily and continuously.

FIG. 112.

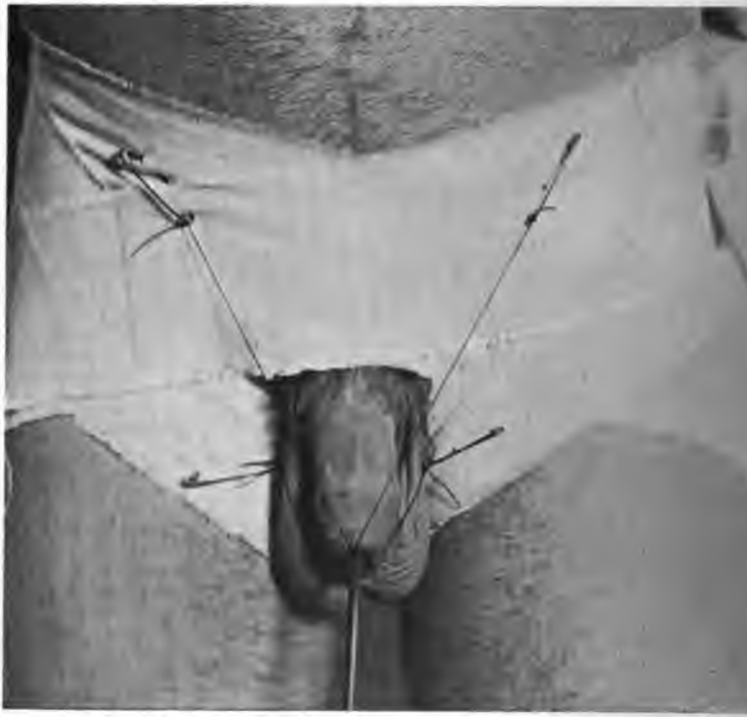


Securing the catheter for continuous catheterization.

When by all these tests the surgeon is sure that the catheter is properly placed, it may be secured in position. The proper placing of the instrument is the most important part of the whole procedure. If the urine does not flow drop by drop, or if there are pain and a desire to urinate, this is usually because the catheter is passed too deeply, and is corrected by drawing it out a little.

The fixation of the catheter is accomplished either by passing threads around it immediately beyond the urinary meatus and ting them to the suprapubic hair, or, better, by fastening these th to strips of rubber adhesive plaster an inch wide applied to eithe of the penis, passing from its root to the level of the meatus, secured in place by two or three circular strips, not passing en around the penis, and a narrow gauze bandage. The threads sh be attached to the catheter close to the meatus, and not at a dis as figured in the illustration (Fig. 112), and are then passed thr holes cut in the free ends of the longitudinal plaster strips. (Fig. Or four threads may be secured to the catheter just beyond th nary meatus, and these may be carried to safety-pins secured double spica of the groin. (Fig. 113.)

FIG. 113.



Securing the catheter for continuous catheterization.

The penis is then enveloped in an antiseptic dressing. A squa gauze made of ten or twelve layers is folded in the form of a trian the apex is secured to the catheter just beyond the meatus by a thread and rubber bandage; the base is wrapped around the p By means of a piece of sterile glass tubing a clean rubber drain tube is attached to the end of the catheter, and is passed in urinal which is half filled with antiseptic solution and placed at a level lower than that of the bladder. The flow must be continuous.

The catheter is changed every one or two days, the anterior urethra receiving a thorough irrigation at the time of changing. The catheter is left open when it is employed for the purpose of a drain,—that is, when it is used to combat infection. When the bladder is aseptic and the urine sterile, the catheter is opened only at regular intervals, depending upon the amount of urine secreted. This form of intermittent drainage is absolutely indicated when long-standing retention is being treated. If the urine contains pus or blood, the residuum which it is considered desirable to leave in the bladder is replaced by boric acid solution. The bladder is not entirely emptied for several days.

Continuous catheterization occasions a mechanical urethritis, which promptly disappears when the catheter is removed. Sometimes abscesses develop, particularly at the scrotal angle of the penis, due to pressure exercised by the instrument on account of the penis being allowed to hang directly downward. Infection of the bladder may occur either from direct extension of urethral inflammation or as a result of the decomposition of the urine with which the interior of the catheter is continually moist. This accident may be avoided by changing the catheter before its surface becomes roughened, keeping its end beneath the surface of a strong antiseptic solution contained in a clean urinal, and twice daily flushing the urethra with hot sterile four per cent. boric solution or protargol solution 1 to 4000. This flushing may be accomplished by means of an irrigating-bag hung four feet above the level of the patient's bladder. The nozzle of the bag is attached to the catheter, and the latter is slowly withdrawn till the antiseptic solution escapes from the meatus. From half a pint to a pint of the solution is used to wash out the anterior urethra; the irrigating-bag is then disconnected, and the catheter is pushed in till it occupies its proper position. Ulceration of the urethral floor may be avoided by supporting the penis so that it is prevented from hanging with too pronounced a curve.

Continuous catheterization having been kept up for eight to sixteen days, and fever, pain, blood, and the greater part of the pus having disappeared, the patient can resort to intermittent catheterization. Exceptionally the bladder can be emptied by muscular effort, the cure being complete. This result, however, cannot be looked for in retention caused by prostatic overgrowth.

Patients whose symptoms have been relieved by continuous catheterization should be told to resort again to this measure should experience difficulty in passing the instrument. The catheter be worn at night or for several hours at a time during the day.

The indications for continuous catheterization and the metho employing it in the treatment of retention may be summariz follows:

1. Continuous catheterization is indicated in retention foll wounds or rupture of the urethra. It is particularly indicated prostatic retention is not amenable to repeated catheterization a complicated by bleeding or by infection and fever.

2. The catheter chosen must be large, thin-walled, and car made; the catheter eye must lie just within the internal vesical sp ter, and must be kept open. The instrument should be cha every second day. Its free end should be kept beneath the su of an antiseptic lotion held in a urinal so placed as to be beneat level of the bladder. The urethra should be flushed out twice with a pint of dilute antiseptic solution. When the urine is steril bladder need not be washed; when it contains pus or blood, it s be irrigated at least twice daily. The catheter should drai bladder continuously when it is employed for the relief of parti tention without marked vesical tension complicated by cystitis fever. It should drain the bladder intermittently when the ur sterile and when it has been introduced for the relief of rete with marked vesical tension.

Continuous catheterization relieves tension, cures cystitis, r the passage of instruments easier, and in general value and v applicability is second only to intermittent catheterization.

Aspiration.—When catheterization fails to relieve retention an enlarged prostate, aspiration is the operation of choice. T safe and easy, and can be repeated very often without causing plications of any kind.

The bladder is outlined by percussion and palpation, the s pubic region is thoroughly cleansed as for a formal surgical oper the large aspirating needle is boiled, and the surgeon's hands are ized. With a sterile sharp-pointed tenotome a puncture is through the skin of the middle line immediately above the symp pubis, and the aspirating needle is thrust downward and back through this incision into the bladder. The lessened resistanc determine when it has penetrated through all the walls o viscus.

The bladder is partially or completely emptied, in accor with the duration of retention and the amount of vesical diste

The aspirating needle is then withdrawn, while suction is still maintained, thus preventing infection of the needle-track with the urine.

These aspirations may be repeated three or four times a day for one or two weeks without infecting the bladder, and usually without causing suppuration of the prevesical cellular tissues. It is worthy of note, however, that a few cases of extra-vesical abscess have been reported, but only when there has been pronounced cystitis.

Incomplete Retention.—The damage inflicted by incomplete retention upon the bladder, ureters, and kidneys is commonly more pronounced and more permanent in its effects than that incident to complete retention, since in the latter case the symptoms are so urgent that prompt relief by catheterization is obtained, whilst in the former, the symptoms being annoying rather than painful, there is a progressive, often rapid, dilatation of the bladder followed by all the evil effects of back pressure.

Patients suffering from incomplete retention due to prostatic enlargement may complain of no symptoms other than undue frequency, slowness in starting the stream, and lack of propulsive force. Cystitis or acute prostatic congestion aggravates these symptoms and supplements them by pain and tenesmus. In the early stages of incomplete chronic congestion before the bladder is markedly dilated, as determined by rectal and suprapubic palpation and measurement of the residual urine, the treatment of these occasional exacerbations calls for active purgation, hot normal saline enemata, hot Sitz baths, diluents by the mouth, a bland diet, and rest in bed. In the absence of vesical infection, the catheter may be omitted unless there is overdistention, when instrumental relief is imperatively called for.

Treatment of Chronic Incomplete Retention.—After the surgeon has relieved the acute retention of prostatics, has checked bleeding, and has cured or alleviated the chronic cystitis from which these patients usually suffer, directions must be given which will prevent a return of complete retention and which will keep the bladder in the best condition to resist microbic invasion and preserve it from the effects of abnormal tension. This necessarily implies the habitual or intermittent use of a catheter. Perhaps a point of prime importance is to convince these patients that the catheter does not cause vesical atony and cystitis, but protects against these sequelæ of prostatic enlargement; that its use does not abolish the power of urination, but may restore it; and that it is infinitely better to draw the water through an instrument than to pass it at the expense of prolonged and violent straining efforts.

Instruction must next be given in the technique of catheterization.

The mere mechanical part is learned quickly enough. The instr
which in each case enters the bladder most readily and give
pain is the best. This may be a soft rubber catheter, an elbow
double-elbowed catheter, the stiff English instrument, or excepti
even the silver prostatic catheter.

The number of catheterizations a day must be regulated
activity of the kidneys and by the frequency with which the patie
periences a strong persistent desire to urinate. In mild cases
ing only from frequent urination at night the passage of an instr
before retiring is usually sufficient. During the day there are
tress, but little delay or straining, a free flow of urine, and no di
ing frequency. In more advanced cases where the urine is still
freely and painlessly, but there is a large residuum with troubl
frequency, the catheter may have to be passed two or three ti
the day. Where there is chronic cystitis or congestion with fre
urgent, painful, and inefficient urination, the catheter may have
used every two or three hours; when the urine is purulent its
ation should always be followed by vesical and urethral irrig
When catheterization becomes painful and fails to give relief, co
ous catheterization should be practised for a few days.

Minute directions should be given patients concerning the c
instruments and a cleanly method of using them. They m
taught the importance of using sterile catheters in accordanc
modern surgical principles. This is especially necessary whe
titis has not developed. The various ingenious contrivances in
patients carry their instruments—for instance, flat boxes and
canes—are not to be commended, since it is almost impossi
keep catheters clean when they are thus stored. Catheterizat
troublesome at best, and thoroughness in carrying out antisept
tails should not be sacrificed to convenience.

The most comfortable catheter having been selected, the
should procure twice as many of these as are required in a singl
a fresh instrument being used for each catheterization. In the
tion of these instruments it is worthy of note that those of Am
make are quite as good as the imported ones, and that the Lisle
and linen catheters are practically as serviceable as those o
silk. In addition to the catheters the patient must secure a met
arranged for their sterilization by paraform, tubes of carbolize
moline, or other slightly antiseptic lubricant, a bottle of tabl
corrosive mercuric chloride for making a solution of 1 to 1
which the hands can be washed, a roll of bichloride gauze, a
irrigating-bag. He should have prepared a dozen clean towels

have been boiled and sun-dried or baked. The catheters are washed in green soap and hot boiled water, washed again in hot water, dried with a clean towel, and wrapped each in a piece of bichloride gauze cut to an appropriate size. They are then loosely wrapped in a towel and placed for ten minutes in an oven kept at about 160° F. They are finally stored in the metal paraform-box for twenty-four hours. (See page 282.)

As each catheter is required for use it is taken from the box, and, with its gauze wrapping still unfolded, is placed on a clean towel. The patient then fills his irrigating-bag with a solution of 1 to 2000 protargol, removes the cap from the lubricant jar, scrubs his hands thoroughly with soap and hot water, washes them in bichloride solution —1 to 1000—scrubs the glans penis with a pledget of cotton dipped in this same solution, again washes his hands in the bichloride solution, unwraps the catheter, dips it for a moment in a pitcher of hot, recently boiled water, hot boric acid solution, or 1 to 10,000 corrosive chloride solution, to remove the paraform vapor, lubricates it carefully, places a clean towel around the penis, and introduces the instrument, attaching the irrigating apparatus after it has been passed in four inches and allowing the antiseptic solution to flow while the catheter is slowly pushed on into the bladder. After the bladder is emptied, the irrigator is again attached to the catheter during its withdrawal. The catheter thus used is immediately washed and syringed out with hot soapsuds, is dipped for a moment in boiling water, is then shaken to dry out its interior as thoroughly as possible, is wiped dry, and is wrapped in a clean towel. At night the hands are cleansed, and the catheters which have been used during the day are again wrapped in bichloride gauze, baked for a few minutes, and put in the paraform-box. This box should be provided with two shelves, each containing enough catheters for twenty-four hours' use.

The baking is not absolutely essential, since its main purpose is to dry the interior of the instruments and thus prevent them from deteriorating.

There are many simpler methods of practising cleanliness in catheterization. We believe the method given above is the most efficient.

When it cannot be carried out, the catheters should be boiled and wrapped in sterile towels. The hands and the glans penis should be washed with bichloride and the urethra should be cleansed by antiseptic injections practised with an ordinary urethral syringe before each passage of the instrument. As the latter is withdrawn, the urethra should again be flushed with the antiseptic.

When about to travel, enough catheters should be sterilized to last at least two days. These, with the catheter case, lubricant, antiseptic towels, gauze, absorbent cotton, a small basin for hand solution, narrow pint jar for rinsing the formalized catheter may be packe small valise.

When the above technique is rigidly enforced, the severe grad traumatic urethritis incident to repeated and frequent unclean terization may be avoided.

When cystitis is present irrigations are extremely valuabl fountain syringe is used, and in general a solution is employed does not excite inflammatory reaction. Even when the urine re sterile, should frequent catheterization occasion a simple uret the anterior urethra should always be irrigated just before the i ment is passed into the bladder and during its withdrawal.

A patient suffering from enlarged prostate should also be careful instructions in regard to the prophylaxis of the cong attacks which so frequently cause acute retention.

The diet must be so regulated that the urine shall be unirri This necessarily implies treatment for oxaluria, excess of uric ac other abnormal condition. Diluents should be given with the end in view, but not to the extent of markedly increasing the po which is usually present. The surface circulation should be s lated by bathing, friction, and massage. Open-air exercise is des for its effect upon the general health. Even horseback riding use of a bicycle is sometimes followed by beneficial results. T stimulants, and nutrients all have their value.

As a means of avoiding local congestions the patients m particularly cautioned against constipation, chilling of the surfac feet, resisting the desire to urinate, sexual excess, indulgence in hol, or overeating. The treatment directed to lessening the h trophy is discussed under a separate heading.

RETENTION OF URINE FROM STRICTURE.

The retention of urine from stricture must be distinguished that dependent upon enlarged prostate, since the treatment two affections is widely different. In both cases there is usu preceding history of frequent urination with slowness in startin stream. Prostatics, however, have most difficulty at night and early morning. During the day the water flows with compa freedom and without much delay. Examination per rectum usually show enlargement of the prostate. In cases of strictu frequency is most pronounced in the day, the delay in startin stream is less marked, and there is liable to be more dribbling. retention is well advanced there is distinct remission of sympto night. A history of previous gleet or of injury to the perineal or the penile urethra is usually given. It must be recognized that sudden retention may develop in cases of stricture of large calibre without a preceding history of frequency.

The diagnosis is generally founded upon exploration of the urethra with acorn-bougies and digital examination through the rectum.

There is probably incomplete retention in the majority of tight strictures, but of a degree insufficient to produce dangerous vesical tension. Any cause of congestion and urethral spasm, particularly sexual indulgence, excess in drink, chilling of the surface, or the passage of a catheter, may make the retention complete. This form of complete retention is, however, of short duration.

Treatment.—Since the bladder has a tendency to become hypertrophied rather than dilated, it is rare in the case of stricture to find it enormously distended. Even when the tension is still moderate, the suffering is so intolerable that the help of the surgeon is demanded. Since spasm and congestion play the major *rôle*, a hot bath, hot enemata, opium and belladonna suppositories, and hot turpentine stupes over the hypogastrium may be tried. If these measures fail, the surgeon should promptly proceed to instrumentation. On the chance of the stricture being of large calibre and of the retention being caused mainly by muscular spasm, an effort may be made to introduce a steel sound, 16 to 20 F., into the bladder. If this fails, fine conical and rat-tailed soft catheters should next be tried. These failing, filiform whalebone bougies should be used, and gently manipulated till one enters the bladder. When the filiform has entered the distended bladder, it may be tied in place, with the full assurance that enough urine will leak out beside it to relieve tension, and that the stricture will be sufficiently softened to allow of the passage of larger instruments.

This is the simplest course, and probably the safest in the majority of cases, especially when patients are treated at their own homes. When they are under hospital supervision, however, good results will be obtained, and more expeditiously, by cutting the stricture to full calibre at once either by internal or external urethrotomy or by a combination of these methods.

When a filiform cannot be passed, aspiration, by relieving tension and congestion and relaxing spasm, will at times be followed by success on subsequent efforts to pass instruments through the urethra. Usually on failure to pass any instrument external urethrotomy is required.

RETENTION OF URINE FROM TRAUMATISM.—Under this headin included that form of retention which follows direct injury of urethra or the bladder. Retention following general trauma, s as that observed in the aged after contusion of the hip or f ture of the thigh, is probably due to disordered reflexes (inl tion of the detrusors or spasm of the sphincters), and is elsewl described.

Rupture of the bladder may cause retention, partly because urine escapes through the rent, partly from muscular palsy. Lac tion or rupture of the urethra always causes retention. The sy toms and treatment of these injuries have been considered u separate headings. The general indications are immediate clo of the rupture and drainage of the bladder either by contin catheterization or by the perineal drainage-tube.

INCONTINENCE OF URINE.

Incontinence of urine results from inability of the bladder t as a reservoir, and is characterized by the involuntary, someti the unconscious, escape of urine. Guyon distinguishes as true in tinence that in which the urine escapes without previous urg or even desire, thus excluding, for instance, those cases of pros cystitis in which the desire is so imperious and irresistible that patient cannot withstand it. He thus tabulates true incontinence

Incontinence.
- Without material lesions of the urinary tract.
  - Incontinence from nerve-lesions.
  - Incontinence from nervous affections.
  - Incontinence of children.
- With material lesions of the urinary tract.
  - Without retention of urine.
    - Mechanical incontinen
    - Incontinence of tubercu
    - Traumatic incontinenc
    - Incontinence from ure insufficiency.
  - With retention of urine.
    - Incontinence of strictu
    - Incontinence of enl prostate.

Incontinence without Lesions of the Urinary Tract.— continence due to nerve lesion is usually preceded by retention, urine escaping drop by drop from the overfull bladder. The ditions, such as the palsies and degenerations, which occasion retention have been already mentioned. The appropriate treatn is regular aseptic evacuation of the bladder.

Incontinence of nervous affections often appears in the form c unconscious escape of urine from the bladder, which is never o distended. Hysteria, neurasthenia, incipient diabetes, and epilepsy occasion this form of incontinence.

Epileptic incontinence is of special interest, since it may be the only symptom to excite suspicion of the nervous affection. Trousseau states that adults who, without lesion of the urethra or bladder, wet their beds at night should be suspected of epilepsy. In these cases suspicion as to epilepsy having been excited will lead to the detection of other symptoms, which may justify a positive diagnosis. In hysteria and neurasthenia the condition is rare. Any violent emotion, particularly fright, may occasion this form of incontinence.

INCONTINENCE OF CHILDREN is essentially a functional disease. It usually begins about the fourth or fifth year, but sometimes is continued from early infancy. There is a natural tendency towards cure at the period of puberty, but many cases persist beyond this time. It is almost invariably nocturnal. Exceptionally it is both nocturnal and diurnal. The cause of this incontinence is unknown. Heredity is a distinctly predisposing factor. The possibility of epilepsy as an etiological factor should always be carefully considered.

Trousseau classifies this affection as a neurosis, characterized by excessive irritability and exaggerated tonicity of the vesical muscles. Perhaps the most satisfactory explanation is that which attributes this perversion of function to an increased irritability of the prostatic uréthra. It has been already shown that as the bladder becomes distended the internal vesical sphincter yields, and the prostatic urethra forms a portion of the urine-containing cavity. With the yielding of the vesical sphincter and the penetration of the urine into the prostatic urethra normally there may be felt merely a slight desire to urinate. It is only when the vesical tension reaches a certain point that the desire to micturate is felt strongly. In cases of posterior urethritis, because of the increased sensibility of the prostatic urethra, the moment the internal vesical sphincter yields and allows the urine to reach this inflamed mucous membrane, the desire to urinate is urgent, imperative, and often irresistible. In the case of a child with a hyperæsthetic posterior urethra, and with spinal reflexes much more readily excited than in adults, particularly during sleep, the escape of the first few drops of urine into the prostatic urethra is probably sufficient to set in active operation the nervous and muscular mechanism of micturition. During the day cerebral control is usually able to inhibit this reflex; but when the prostatic urethra is particularly irritable the reflex is excited so suddenly that urination takes place before the child has time to control it by a conscious effort.

Diagnosis.—Before deciding that a child who wets his
night or soils his clothing in the daytime is suffering from a
functional trouble, diabetes, polyuria, vesical tuberculosis, c
nephritis, calculus, and foreign body must be eliminated.
urine is perfectly normal, and is not excessive in quantity, and if
tion is painless and is normally accomplished, these various
of incontinence can be eliminated. Epilepsy must be exclud
having the child watched through several nights.

Treatment.—Since incontinence in children is often due to
aggerated reflex, a careful search must be made for any abnor
which may indirectly lead to such increased reflex excit
Thus, the anus and the rectum should be examined for polyp, e
fissure, or seat-worms. The urethra should be explored for n
ings or valvular formations, and, since most children are phim
is well on general principles to practise circumcision. This i
is often curative. Errors of diet must be carefully corrected, a
urine rendered bland by giving water and milk in abundance. I
should not, however, be given in the evening. The total quan
urine passed in twenty-four hours should be measured. Th
show that the incontinence is really due to over-distention, the
secreting during the night more urine than the bladder can ret

The general system should be strengthened by exercise
open air, regular bathing, massage in the case of very weak ch
and the administration of tonics. Compound syrup of the
phosphites in doses suited to the age is particularly serviceable.
well to encourage the child in the habit of defecating imme
before bedtime. This end may be accomplished by the regul
of enemata. If the examination of the urine shows oxala
other sediments in excess, the appropriate dietetic regulations
be enforced.

It sometimes happens that a habit of nocturnal incontine
due originally to carelessness. The child, though awakened
desire to urinate, prefers wetting his bed to getting up. Sho
is so imperfectly awakened that, though micturition is p
volitional, he is practically unconscious of the act. It will be
that the urine is passed at about the same hour every night.
nurse is directed to inspect the child hourly for two or three
the time of semi-conscious urination may be determined.

In these cases a cure may be accomplished by having the
waked at about one or two in the morning, or an hour befo
habitual time of involuntary micturition, and made to emp
bladder. This treatment may be reinforced by a system of re

and punishment. The child should never be severely disciplined. since perhaps in the majority of cases the disturbance of function is entirely beyond his control.

As further means of lessening the tendency to nocturnal enuresis, the application of a bandage about the waist of the child, with a projection in the back so that he is compelled to lie on his side, sleeping on a comparatively hard bed with covering just sufficient for necessary warmth, the elevation of the foot of the bed, and counter-irritation in the form of blisters over the lumbar spine, have been tried with apparently satisfactory results.

Medicinal Treatment.—The drugs administered for the cure of enuresis in children are belladonna, atropine, hyoscine or hyoscyamine, potassium bromide, and quinine.

Belladonna, the drug upon which reliance has been chiefly placed, is administered in ascending doses until either the physiological effect is obtained or the incontinence is cured. This drug is pushed to the limit of safety; thus, a child four years old may be given an eighth of a grain of belladonna extract, four drops of the tincture, or one to two minims of the fluid extract of the root in the evening. Or the drug may be given in the form of suppository, the dose then being slightly larger. Hyoscine or hyoscyamine may be employed in doses of the two-hundred-and-fiftieth of a grain; potassium bromide, five to fifteen grains; quinine, two to ten grains.

If the desired result is not quickly accomplished, no benefit is obtained by continuing these drugs. Sometimes the enuresis is apparently cured at once. Under these circumstances the dose should be gradually lessened. If there is temporary relief followed by relapse, the dose may be cautiously increased. Quinine has been particularly commended by Potts, on the theory that enuresis is probably caused in the greater number of cases by failure of the higher centres to control properly the reflex act by which the bladder is emptied. Quinine was given in full doses as a stimulant to the inhibitory centre, with strikingly satisfactory results in the few cases in which it was tried.

Mechanical Treatment.—When the methods already discussed have failed, the prostate and the urethra should receive direct mechanical treatment. This may be applied in the form of (1) sounds, (2) electricity, (3) instillations, (4) epidural or presacral injections.

Its object is to relieve the hyperæsthesia and congestion of the prostatic urethra and to stimulate the sphincter muscle.

The passage of a cold steel sound of such size that it enters the bladder without the employment of force is usually efficacious. This

sound should be left in place for from three to five minute
should be passed every third or fourth day.

If after three weeks of sounding and a fourth week of rest
toms are not improved, electricity should be employed. This
plied by means of a urethral electrode vulcanized to within a
of its extremity, shaped like a sound, and with the rather sharp
appropriate to the urethra of children. The electrode is passe
the urethra until its metal extremity lies within the membranou
prostatic portions of this canal. It is then attached to the
battery, the other electrode of which is applied over the perine
to the lumbar spine. The patient is given fifty slow interru
the current being so regulated that it does not cause pain. The
ment is repeated every three or four days. The rectal electr
less painful and nearly as efficacious.

If in three or four weeks electrical treatment does not impr
cure the enuresis, instillations of silver nitrate may be emp
From three to five drops of a two to five per cent. solution
jected into the membranous or prostatic urethra every third or
day.

Should the incontinence still persist, epidural or retro-rectal
tions may be tried.

The epidural injection is made into the space between th
and the periosteal lining of the vertebral canal. This space e
from the sacro-coccygeal ligament to the foramen magnum, at
point the dura and periosteum unite. Laterally the epidural
is closed at the intervertebral foraminæ. A colored fluid injecte
this space will stop abruptly at the points of termination men
and remain exclusively intravertebral, not entering the craniu
subarachnoid space, nor coming in contact with the nerve sub
If the injection be made at the lowest point of the sacral canal,
stain the pelvic cellular tissue and the ischio-rectal fossæ becaus
are no dural adhesions at the intervertebral foramina in the
third of the sacral canal.

About one or two centimetres (.4 to .8 of an inch) above the
gluteal fold, is the flat triangular sacrococcygeal space, the uppe
or base being formed by the convex bulging ridge of the first
vertebra terminating at the lateral sacral cornua. The distan
tween this space and the tip of the coccyx is about six and or
to seven centimetres (two and one-half to three inches). In
individuals digital exploration will be necessary to determine the
location of this space. Its mid-portion is the best site for the
tion. Through a skin puncture made under local anæsthesia

sharp-pointed tenotome the needle should be inserted to a depth of one and one-half to two inches (three to five centimetres) in the mid-line (to avoid injury to the coccygeal nerves or ganglia) and in a forward and upward direction. As the sacro-coccygeal ligament is punctured, its density is readily appreciated, and thereafter the tissues hold the needle somewhat rigidly.

From five to twenty cubic centimetres of normal salt solution may be given three times a week. Some cases require repeated injections. A remarkable feature in the reported results of this treatment is that excessive desire to urinate is said to be diminished and deficient desire to be stimulated. The operation is rarely painful and the treatment if carried out as above described is not likely to do harm.

Jaboulay commends retro-rectal injections as simpler in administration and even more efficacious. The needle is introduced at the tip of the coccyx and passed vertically upward for two inches, a finger in the rectum guarding this portion of the bowel against puncture. Two hundred cubic centimetres of normal salt solution are slowly injected in adults—about quarter the quantity in children. Some extraordinary cures are reported, the cures being explained on the basis of a mechanical impression on the hypogastric plexus. Should this method fail, recourse must be had to the local application of electricity, and this should be continued over a long period,—from six to eight months,—or even a year.

If the enuresis is purely functional, many children will get well, after attention to their general hygiene, if they abstain from liquids in the evening, empty the bowels and bladder before going to bed, and rise once during the night to micturate.

Though it is customary to advise as the next means of treatment the administration of drugs, we are in general opposed to this, believing that better results are more promptly attained by local treatment, provided the attendant is fairly skilful in the use of urethral instruments and recognizes the importance of thorough cleanliness in all his manipulations.

When the enuresis has lasted past the age of puberty, the best results will be obtained from the use of full-calibre sounds, instillations, and possibly from epidural or presacral injections.

Incontinence with Lesions of the Urinary Tract.—When enuresis is not functional, but is due to hypersecretion or to tuberculosis, for instance, the cause must receive treatment.

Incontinence without retention of urine is necessarily dependent upon a patulous condition of the sphincter. This may be caused by lodgement of an irregularly shaped stone, by which the vesical sphincter is kept open but is not occluded. This form of incon nence, Guyon states, is observed only in children.

Such a condition should be treated by pushing the stone ba into the bladder and removing it by litholapaxy, or, in case this impossible, by perineal section.

Tubercular ulceration may infiltrate and entirely destroy t vesical sphincters, resulting in an intractable form of incontinen the nature of which is rarely doubtful, since it develops only in t advanced stage of vesical tuberculosis.

Incontinence due to contusion or overstretching of the prosta such as occurs in perineal lithotrity or in digital examination of t female bladder through the urethra, may persist indefinitely. T nicity of the sphincter muscle is best restored by the application local electricity.

Incontinence due to fistulous opening of the bladder is elsewh discussed.

Guyon describes under the heading urethral insufficiency a fo of incontinence characterized by involuntary escape of urine caus by the slightest muscular effort, such as coughing, laughing, or stra ing, or even by standing. The urethra is perfectly normal. Wom especially suffer from this form of incontinence, because of atonic of the vesical sphincter. Sometimes it is seen in men after stret ing of the prostatic urethra or the use of very large sounds.

Electricity supplemented by instillations is serviceable in th cases. In women, when this method of treatment fails and the esca of urine is profuse, as a last resort the urethra may be freed by d section through the greater part of its length, given a half or a thr fourths twist in its long axis, and sewed in this position.

Incontinence of retention is the ordinary form of incontinen and is observed particularly in those suffering from enlarged prost or from stricture. Distinction should be made between this form incontinence, in which the urine dribbles without either the volition the consciousness of the patient, and the urgent, imperious urinati of cystitis or of irritable bladder. The true nature of this inc tinence is of course at once recognized by vesical palpation, and t nature of the obstruction is determined by the previous history a by urethral examination.

When in this form of incontinence the urethra is patulous and of normal length, the cause must be sought in the nervous system.

As for treatment, this is directed to the relief of the retenti rather than to the incontinence, and has been already discussed.

HÆMATURIA.

The vascularity of the urinary tract and the readiness with which it becomes engorged are reasons why blood is so frequently found mixed with the urine. The bleeding may be profuse and from apparently slight causes. Guyon gives the exciting causes of hemorrhage as traumatism, congestion, inflammation, organic disease, foreign bodies; or, as a still more simple classification, the bleeding may be mechanical, inflammatory or congestive, or organic.

It is important not to regard the color of the urine as sufficient evidence of the presence of blood, since an excess of uric acid or bile-pigments, or the ingestion of senna, rhubarb, or carbolic acid, or the presence of hæmoglobin, will give a reddish or a brownish tint, absolutely like that due to the presence of blood.

It is upon microscopic, spectroscopic, and chemical examination that the diagnosis must be founded. (See page 346.) The color may vary from a rosy red to a deep brown. When together with blood there is pus, as in cases of acute and chronic cystitis, the blood may be found entirely in the sediment, being somewhat irregularly mixed with this deposit and imparting none of its color to the supernatant liquid.

The lower the specific gravity of the urine the more readily the blood dissolves in it, and hence the slower the clot-formation. This fact has an important bearing on treatment, suggesting the use of diluents when there is danger of retention from clotting.

The clots which are passed have no diagnostic significance, with one exception: a long, thin, rounded clot in the shape of a small earthworm must necessarily have been moulded in the ureter, and hence indicates either renal or ureteric origin of bleeding. Short cylindrical clots have not the same significance, since they may have been formed in the urethra.

The clots may be dark red and readily broken up, or tough and yellowish red, suggesting the appearance of organized tissue. A microscopic examination is required to distinguish these fibrinous clots from fragments of neoplasm.

Since congestion is so important a predisposing condition to hæmaturia, it sometimes happens that symptoms of this engorgement will precede hemorrhage. There may be a sensation of weight and discomfort rather than actual suffering, or an attack of kidney colic. These pains are of brief duration, are felt in the region of the kidneys or along the ureters, and strongly point to the renal origin of bleeding. Such premonitory pains are rarely felt in bleeding from the bladder.

The source of hæmaturia is sometimes indicated by the color of the blood or by the time of its appearance in the urine.

Blood which appears with the first jet of urine (initial hæmatu the remainder of the liquid remaining clear, must necessarily c from some portion of the urethra. In this case the quantity of bl must be very slight, otherwise it would escape externally if it c from the anterior urethra, or would flow back into the bladder if f the prostatic urethra. Usually when the blood comes from the p tate there is also terminal hæmaturia; that is, the last portion of urine may contain blood, or almost pure blood may be passed.

When all the urine contains blood, but that last passed cont the greatest quantity, the last few drops micturated being nearly bright blood, the probability of the vesical or prostatic origin of bleeding is very strong. If blood is passed only at the end of turition (terminal hæmaturia), the blood must necessarily come either the bladder or the prostatic urethra. It is particularly in p tato-cystitis that terminal hæmaturia is observed. The bleedin not profuse, and is associated with other symptoms of cystitis, not frequency and urgency. In severe injury to the kidney or malig growth of this organ, the blood may be bright red and the hæmat may appear to be terminal. When bleeding follows traumatism origin will often be indicated by the character and seat of the inj Thus, in case of gunshot wound in the lumbar region the appear of blood in the urine would necessarily indicate injury of the kid while hæmaturia following a kick in the hypogastric region w suggest contusion or rupture of the bladder. Blood escaping i pendently of the act of micturition must come from some part of anterior urethra.

The quantity of blood in the urine is of some diagnostic value. the bleeding is apparently causeless, intermittent, and profuse, usually due to renal or vesical tumors, though tropical parasites in urinary tract, notably the distoma, may cause severe bleeding.

Bleeding may be caused by cantharides, turpentine, mercury the ingestion of certain foods. Renal telangiectasis has been repo as a cause for blood in the urine, and this symptom regularly foll renal thrombosis and infarcts.

Blood may appear in the urine in the course of hæmophilia because of parasites (filaria sanguinis hominis), closely simulating surgical forms of hæmaturia. When it is due to infectious fe such as variola or scarlatina, to dyscrasiæ, such as scurvy or pura, or to hysteria, it is not likely to be confounded with hæmat which is mainly local in origin.

When hæmaturia follows sudden muscular action or appare insufficient violence, this is probably due to the presence hitherto unsuspected lesion. The conditions which commonly precede the bleeding are tumor, tuberculosis, and nephritis.

In general terms, when urination causes bleeding, stone, tumor, or tuberculosis may be suspected. Hæmaturia due to new growth, whether this be of the bladder or of the kidney, is usually profuse, apparently causeless, intermittent, made worse by exercise, not cured by rest. As the disease progresses, paroxysms have a tendency to occur more frequently.

A tumor, if not placed near the vesical neck, may occasion no symptoms other than hæmaturia, and in its early stages may readily escape detection by palpation. The renal origin may be suspected after elimination of the vesical source of the hemorrhage. This suspicion will be changed to a surety if associated with the bleeding, or preceding it, there have been attacks of renal colic.

Guyon calls attention to a symptom which may aid in making a differential diagnosis. In kidney tumor the blood sometimes suddenly disappears, to return as suddenly. These alternations are repeated at short intervals. It may be for only a few hours that the urine remains limpid, and then the blood again appears, often containing a clot moulded in the ureter. This sudden clearing of the urine is due to temporary blocking of the ureter; the bladder then contains only the excretion of the healthy kidney. When, together with blood, renal blood-casts are found, the origin of the bleeding is positively indicated. Attacks of renal colic are equally characteristic.

In determining the source of bleeding, evidence afforded by analysis of associated symptoms and by direct examination must be carefully considered. If the bladder is sufficiently affected to cause bleeding from its mucous membrane there will usually be frequency, urgency, and pain if the case be inflammatory, mechanical, or traumatic; or a bimanual examination will show some alteration in the vesical walls or in the prostate if there be infiltration or tumor.

Vesical tumors are usually complicated by cystitis, due to catheterization. This is not so common in renal tumors, or, if it develops, follows the bleeding by a longer interval, and is much more amenable to treatment.

The first symptom of tumor of the bladder is hæmaturia, unless the growth is placed near the vesical orifice, in which case frequent micturition may precede the appearance of blood. (Fenwick.)

The bleeding from chronic Bright's disease is moderate; exceptionally it is intermittent and profuse. Other symptoms of the disease, and particularly the results of urinary examination, suggest the cause of hemorrhage. The hemorrhage of syphilitic glomerular nephritis can be diagnosed only by the associated symptoms o disease.

Hæmaturia of renal tuberculosis is characterized by pain, amounting to true renal colic, pus in the urine, which persists, a moderate amount of blood, appearing intermittently. Renal cal also occasions but a slight amount of bleeding and causes pa the back which is reflected in various directions. The bleedin attacks of colic, and the pain are relieved by rest. This is also tr the hæmaturia thus associated with obstructive hydronephrosis. same amelioration is not noted in either tuberculosis or new grow

Stone in the bladder, in addition to the typical symptoms, ca blood in moderate quantity. At times when the stone is complic by enlarged prostate blood is the only symptom. Bleeding tuberculosis of the bladder is also slight, occurring particularly a end of micturition. The symptoms are much like those of s Acute posterior urethritis also occasions bleeding at the end of u tion. The effect of rest upon symptoms of stone is so marked immediate that this is a diagnostic sign of distinct value. Hæma which is not materially influenced by either exercise or rest is us due to tuberculosis, new growth, or acute inflammation. The and vesical hemorrhage following catheterization of an overfull bla has already been discussed; acute cystitis may exceptionally such free bleeding that the term hemorrhagic is applicable. A reported cases seem to prove that varicose veins or atheroma arteries may by rupturing give rise to serious, even fatal, hemorr Enlarged prostate may also cause spontaneous bleeding.

The final determination as to the source of hæmaturia must pend upon cystoscopic examination. Practically it is only in case malignant growth, or possibly in those of tuberculosis, that assoc symptoms fail to suggest the origin of the blood. The examin may be made either in the interval between attacks or during course of the bleeding, but if the hemorrhage is even modera quantity and from the vesical region, nothing can be seen, since fluid injected into the bladder at once becomes opaque from ad ture with blood. If the bleeding is moderate and of renal origin using the irrigating cystoscope the blood may be seen escaping the ureter. The bladder should first be emptied of its bloody u and then filled quickly with clear fluid. A bloody jet may be escaping from the ureter before the liquid contained in the bla becomes too deeply stained to allow of further examination.

It is always best to make a cystoscopic examination in the i vals of bleeding, but when hemorrhage is supposed to be of origin and is slight in amount, it will be impossible to determine from which ureter the blood comes unless the cystoscope is used while bleeding is still going on.

If an examination made after bleeding has ceased shows that the bladder is healthy, this of course points to the renal origin of bleeding. If, on repeated trials, the urine previously having been nearly or quite free from blood, the introduction of the cystoscope at once occasions such free hemorrhage that examination cannot be made, this is itself indicative of the vesical origin of the hemorrhage and almost positively points to new growth.

Treatment of Hæmaturia.—During an acute attack of bleeding, whatever be its cause, rest in bed, liquid diet, preferably milk and buttermilk, diluent drinks, for the purpose of lessening the tendency to coagulation, and a solvent condition of the bowels procured by enemata are advisable on general principles.

Medication by the mouth is of little value. Guyon speaks well of turpentine. This may be given in three-drop doses hourly for six or eight hours, preferably well diluted in the form of a mucilaginous emulsion. Ergot and ergotin have been strongly commended, and may be given in full doses,—a drachm of the former or five grains of the latter at hourly intervals. Oil of erigeron also seems serviceable at times,—five drops in an emulsion every hour. Gallic acid is credited with some hæmostatic powers. It may be given in ten-grain doses every hour.

When the bleeding is profuse and threatening to life, and there are associated with it restlessness and anxiety, tenesmus, pain, and often an over-distention of the bladder from clotting and urethral obstruction, the best results will be obtained by quieting the circulation, and lessening spasm by a full dose of morphine, and emptying the bladder by the catheter and suction syringe. This may be followed by irrigation with a hot astringent antiseptic solution, such as silver nitrate 1 to 2000, fluid extract of hydrastis (colorless) an ounce to one pint, after such irrigation there may be injected a half ounce of adrenalin chloride 1 to 5000 or the same quantity of antipyrin solution, five per cent. Antipyrin possesses distinct value as an analgesic, and is credited with being a powerful hæmostatic. Continuous catheterization is indicated till the bleeding ceases. If the use of the catheter is impracticable, perineal cystotomy is the operation of choice, followed by the removal of clots by the scoop or finger, assisted by lavage with a bichloride or antipyrin solution, and the insertion of a large drainage-tube.

Most minute antiseptic precautions must be observed in all these manipulations, since the urinary tract in case of bleeding is peculiarly susceptible to infection, which if once started is liable to resist treatment and extend rapidly to the kidneys. The dangers are part larly great in cases of neoplasm.

The bleeding of prostatics, dependent upon the intense engo ment which complicates retention, if profuse and threatening to is best treated by evacuating the blood by means of a catheter syringe and keeping the bladder empty by the retained catheter. the clots cannot be removed in this way, perineal or suprapubic totomy is indicated. If bleeding persists, pressure above the pu applied by means of compresses, must be tried.

Hemorrhage from prostatitis and prostato-cystitis relieves engo ment. If moderate, it is often benefited by balsams combined diluents and by the rectal use of opium. The same treatmen applicable to tubercular cystitis. Renal hemorrhage, if persistent threatening to life, should be treated by exploratory nephrotomy. operation is often curative even though no cause be found for bleeding. Further detailed treatment of hæmaturia is given in sections devoted to the pathological conditions which cause it.

EXAMINATION OF THE URINE.

Alterations in the urine are clinically reliable only when the regimen, and life-conditions of the patient have been taken into car consideration. Under certain conditions the diet alone may be sponsible for an albuminuria or a glycosuria; and it would be obvio misleading to make a quantitative determination of urea or of lime example, without knowing the character of the patient's food.

Alterations in the Quantity of Urine.—The normal quan may vary from one to five pints per diem, depending upon vari obvious conditions; the average is from two to three pints. quantitative variations are classified under the headings polyu oliguria, and anuria.

Polyuria is an excess in the total bulk of urine beyond the phy logical maximum, and the excess may reach two gallons, or e more. Polyuria occurs in diabetes mellitus, insipidus, and ph phaticus; in interstitial nephritis and amyloid degeneration of kidneys; in cardiac hypertrophy; in pyelitis; following thermal cr and during convalescence; and in many functional and organic eases of the nervous system, such as conditions of excitement, nerv tension, and overwork. Periodical polyuria is observed during absorption of large exudations, and is sometimes a suggestive symp of hydronephrosis or obstructing renal calculus.

Oliguria, or quantitative diminution of the urine, is present fevers and infections; excessive sweating or prolonged diarrhœ when the circulation is disturbed; or when local pressure upon renal vessels by tumor, ascites, or torsion interfere with the renal circulation; in acute glomerulo-nephritis and acute and chronic parenchymatous and septic or suppurative nephritis; in many cases of hydronephrosis, renal calculus, tuberculosis, or malignant disease of the kidneys; in some nervous diseases, when transudates or exudates are forming; and after anæsthetics, where nephritis is present.

ANURIA is the complete suppression of urine. There are two varieties. (See page 293.)

In one the main fault lies in the renal structure; it occurs in some cases of nephritis, especially the post-scarlatinal nephritis, in the intoxications of the infectious diseases, especially cholera, and in profuse diarrhœas. Exceptionally it is due to the pressure of a tumor or of ascites, or may be produced by poisons, such as cantharides. In these cases the symptoms of uræmia appear early.

The second variety of anuria is due to reflex inhibition. It is seen in hysteria and in other functional and organic nervous diseases. Apparently it is shown that a calculus by blocking one ureter or irritating the pelvis of one kidney may cause complete bilateral suppression, and complete suppression has been produced by torsion of the vessels of one floating kidney. It also occurs in intestinal strangulation or other obstruction. In these cases the symptoms of uræmia are for a long time deferred.

Alterations in the Specific Gravity.—These are important, because, if the total quantity of urine be borne in mind, they are often an index of the quantity of metabolic excrementa.

The normal specific gravity may vary from 1010 to 1030, averaging about 1018 to 1020.

With a normal elimination of the metabolic products the specific gravity will be high in oliguria and low in polyuria in proportion to the concentration or dilution. Low specific gravity of the urine in parenchymatous nephritis is a sign of diminished elimination of the organic constituents; the low specific gravity in interstitial nephritis and in diabetes insipidus is largely due to dilution. In chronic nephritis a sudden fall in specific gravity is often a prodrome of uræmia. The specific gravity is reduced by decomposition within the bladder. The high specific gravity in diabetes mellitus is not always proportionate to the amount of sugar in the urine.

Alterations in Color.—Normally the urine is a clear straw-yellow. The color of the normal urine is largely due to urobilin and uroerythrin, and varies considerably. The color in polyuria is generally pale, in oliguria dark. It is dark in most febrile conditions.

Bile gives it a brownish-yellow color, often with a tinge of green;
foam formed by shaking it is yellow,—a condition, however, w
may be produced by an excess of urobilin.

An excess of the aromatic sulphates gives the urine a deep-br
color, also seen in cases of pathological urobilin. Blood tinges
urine from a pale pink to a deep red.

Alkaline urine is a cloudy, flocculent yellow. A great deal of
produces a milky opacity. The appearance in chyluria is tha
thin cream. Acid urine is usually clear; cloudiness due to salt
uric acid clears on gentle heating.

Carbolic acid and the allied coal-tar compounds appear in the u
in part as hydrochinone, giving a smoky black color; others, as
coal-tar antipyretics, sulphonal, and the allied hypnotics, may pro
hæmatoporphyrinuria, causing a pink or red color. Santonin prod
a yellowish-green color; rhubarb and senna a brown or reddish t

Alterations in Reaction.—The reaction of the total day's u
is faintly acid, due to acid phosphates and urates. There is gene
an alkaline wave at the height of digestion. The acidity is espec
increased in fever, in diabetes, and often in the blood dyscrasiæ,
prolonged muscular exercise.

The reaction is alkaline in phosphaturia, and in all condition
sociated with decomposition of the urea within the tract, particu
in cystitis. An animal diet increases the acidity, a vegetable
decreases it.

When large transudations are being formed, the acidity of
urine is increased; it is decreased when the transudates are being
sorbed. The urine is alkaline during an attack of paroxysmal ha
globinuria and following serous transfusions or large subcutaneou
intravenous saline injections. There are some obscure alteration
metabolism in which the urine is alkaline.

All the mineral acids and most organic acids, especially boric
benzoic acids, increase the acidity of the urine. The hydrates
carbonates of sodium, potassium, calcium, and magnesium, and
salts of the vegetable acids which are eliminated as alkaline car
ates,—acetic, citric, tartaric acids, etc.,—diminish the acidity or re
the urine alkaline.

**Quantitative Alterations of Normal Constituents.—C
rides.**—The chlorides in the urine are of sodium, potassium, am
nium, and magnesium. The amount on a mixed diet correspond
from one and a fourth to three drachms of sodium chloride daily.

The elimination is increased by excessive exercise; in hæmatu
following the absorption of large exudates; in poisoning by pyrog

acid, methyl chloride, and all other agents which disintegrate the blood; in malaria and acute interstitial hepatitis; and following a chloroform narcosis. The elimination is decreased in fevers, and especially in the exudative stages of pneumonia and the acute serous inflammations; in poisoning by phosphorus and carbon monoxide; in some cases of chronic nephritis; in dilatation of the stomach; in all cases of profuse intestinal discharges; in inanition; and in hunger. The chlorides are estimated as silver chloride by the volumetric or the gravimetric method.

Sulphur.—Sulphur exists in the urine mainly as preformed sulphates of sodium, potassium, and calcium, as the ether sulphates, and as neutral sulphur. The total quantity corresponds to from one and five-tenths to three grammes of sulphuric oxide per diem; the ratio of the preformed to the ether sulphates varies from ten to one to eighteen to one.

The aromatic sulphates are strikingly increased in many conditions: in most infectious fevers, and especially in advanced tuberculosis; in intestinal putrefaction of all kinds, and in intestinal obstructions; in internal suppuration, especially of the large serous membranes, in internal gangrene, and in rapid muscular atrophy due to any cause; in diabetes; and in poisoning by the phenol compounds, thymol, ichthyol, camphor, phosphorus, the salicylates, and the aromatic oils, as terebene, etc.

Indican is one of the ether sulphates (indoxyl-sulphuric acid), and, as it possesses a striking reaction, it has been largely taken as the most available clinical representative of this group. A convenient test for indican is to add to ten cubic centimetres of urine one or two cubic centimetres of a twenty per cent. aqueous solution of plumbic subacetate, and filter; to the filtrate is added an equal volume of a one-half per cent. solution of ferric chloride in strong hydrochloric acid, and the mixture thoroughly shaken, when the indigo-blue reaction appears, and the coloring matter can be extracted with chloroform. If intestinal conditions can be excluded, a strong reaction of indican can be taken as evidence of rapid disintegration of albumen somewhere in the system.

The neutral sulphur constitutes about fifteen per cent. of the total sulphur; it consists of organic compounds. It is strikingly increased in all cases of obstruction of the common bile-duct, and to a less extent in non-obstructive jaundice.

Sulphur may also appear in the urine in the form of sulphuretted hydrogen. It may enter the urine through fistulous tracts, may penetrate the bladder from adjacent necrotic areas, and may be evolved in the urine of severe cases of cystitis through the action of a sp bacterium.

The amount of total sulphur should be estimated as ba sulphate; the aromatic sulphates are estimated by the Baum Salkowski method; the presence of sulphuretted hydrogen ca determined readily by its odor and its reactions with the metals.

Phosphates.—Phosphates are present as the diacid, acid, simple sodium, potassium, calcium, and magnesium phosphates, ratio of the alkaline to the earthy phosphates being as 2.5 to 1. total amount corresponds to from three to four grammes of phosp oxide daily. The acid salts are most soluble, the basic least o True phosphaturia, an actual increase in the elimination of p phoric oxide, is very rare, though it does occur in some case obscure diabetes phosphaticus, in saccharine and insipid diabete meningitis, in phosphorus poisoning, and in tuberculous bone dis An excess does not occur in rachitis nor in osteomalacia.

There is a form of so-called phosphaturia with alkaline urine, the consequent precipitation of the phosphates, not connected cystitis or other inflammatory condition: while it is quite certain this is not dependent on an excess of eliminated phosphates, it i known whether it is caused by an increased alkalinity of the b (which may be due to the diet) or to a reflex secretive anomal the kidneys secondary to some functional neurosis. It is espec seen in neurasthenics with gastric disturbances. The phosphate of surgical interest because of their precipitation by the alkaline u of cystitis and the relation of the sediment to calculus.

The total phosphates are estimated by titration with ura nitrate. The phosphatic precipitate of alkaline urine has a wh color, and is dissolved by the addition of sufficient acid to rende urine acid in reaction.

Carbonates.—There is carbon dioxide in solution in the u and the alkaline calcium, magnesium, and ammonium carbonates in minute quantities. They are increased by fever, by a fruit or v table diet, and particularly in the alkaline urine of cystitis, when carbon dioxide is derived from the decomposition of urea.

SODIUM is present in the urine to the extent of from four to grammes (estimated as oxide) daily. It is especially decrease fevers, and is increased in hæmaturia.

POTASSIUM.—The urinary elimination of potassium averages tw three grammes daily. It is not much affected by fevers, but markedly increased in conditions of rapid breaking down of tissue acute yellow atrophy of the liver, internal suppurations, and hæmat

AMMONIA.—The quantity of ammonia eliminated daily is from one-half to one gramme; this is much increased in fever, in most hepatic diseases, and in diabetes. Very large amounts of ammonia are formed in the alkaline decomposition of cystitis.

MAGNESIUM AND CALCIUM are eliminated to the extent of 0.12 gramme and 0.25 gramme respectively daily. The proportional excretion is less in infancy, in old age, in pregnancy, in fevers, and in profuse intestinal discharges. An excess is seen in some cases of phthisis, of organic brain disease, of diabetes, of ostitis, and of tumors of bone, also in chyluria. The calcium elimination (as well as absorption) is normal in both rachitis and osteomalacia.

Urea.—The amount of urea normally excreted varies from twenty to forty-five grammes daily. The formation and elimination are increased in a rich albuminous diet; in fever; in bacterial or leucomaine intoxication; in conditions of tissue-absorption due to any cause, as in the severe anæmias, in scorbutus, diabetes, and chronic constipation; during the absorption of exudates or transudates; by hot or cold baths; by many drugs, as chloroform, caffeine, morphine, and the salicylates; in poisoning from arsenic, antimony, phosphorus, and carbon dioxide; and in cases of severe dyspnœa. The elimination is decreased in a vegetable diet; in starvation and malnutrition; in nearly all the acute and chronic hepatic diseases, especially acute yellow atrophy; and in nearly all cases of organic renal disease, with the exception of primary interstitial nephritis. Of drugs, the bromides especially reduce the urea. It is irregularly increased or decreased in various functional and organic nerve diseases.

The quantitative estimation of urea can be approximately accomplished by the hypobromite method with the use of Doremus's apparatus. A much more accurate but more difficult determination is to make a total nitrogen estimation by the Kehldahl method. Crystals of urea nitrate may be prepared for microscopic examination by the addition of an excess of nitric acid to a concentrated alcoholic solution of urea, made by adding alcohol to urine which has been evaporated to a syrupy consistence, filtering, and again evaporating.

Uric Acid.—The daily elimination ranges from one-tenth to one gramme. It is increased after an albuminous diet, in acute fevers, in all conditions associated with exudation, in leukæmia, in some dyspepsias, in phosphorus poisoning, and in some nervous diseases. The salicylates, pilocarpine, alkaline carbonates, glycerin, and hot baths stimulate the output of uric acid. The elimination is decreased in hunger, in some cases of nephritis, in diabetes, the anæmias, and lead poisoning, and by quinine, atropine, and alcohol. The excretion in

lithæmia, gout, and rheumatism is irregular, and variations are in
stant both during and between attacks, so that the amount is no
index of the presence or severity of any of these conditions.
acid should be estimated by the Salkowski silver method.

KREATININ is eliminated to the extent of one gramme daily, e
that it is increased in all conditions of rapid tissue-disintegration,
fevers, suppuration, and gangrene, we have no knowledge of it w
has a clinical application. It reduces cupric sulphate in alkaline
tions, and may thus give rise to fallacy in the test for sugar by Fehl
test, since it holds the copper suboxide in solution.

The compounds known as the xanthin bases exist in trac
normal urine. They are increased in leukæmia and in some
ditions of auto-intoxication.

The many compounds of the aromatic series normal in urine
apart from the diet, due to bacterial disintegration of proteids e
in the alimentary tract or in the tissues. They circulate part
oxyacids and partly as ether-sulphates, under which heading p
logical alterations have been included.

Closely allied to the xanthin bases and the aromatic series ar
ptomaines and toxins, of which normal urine contains a trace.
are increased in many conditions, and are to be viewed as elin
tions of poisons absorbed from the alimentary tract or from dise
areas formed in the body by the chemical actions of bacteria c
an altered metabolism. The clinical examination of these substa
has not yet been formulated.

Oxalic Acid.—Normal urine contains a trace of ammonium
alate, 0.05 gramme. Although the oxalates in the diet are p
absorbed and partly eliminated, the normal oxalic acid in the uri
not derived from the diet, but is a product of metabolism. The am
is strikingly increased in diabetes, in jaundice, and in many case
chronic gastritis and enteritis; to a less degree in the infectious
eases and in functional and organic nervous diseases. It is also
tain that oxalic acid may be formed in the bladder in certain
of cystitis.

There is an obscure condition known as essential oxaluria o
oxalic diathesis, in which the elimination of oxalic acid is mark
though irregularly, increased. In these cases of oxaluria the
an especial tendency to the formation of calculus. Though ess
oxaluria has been shown to be connected with disturbances of e
the nitrogenous or the carbohydrate metabolism, there are no c
tions in the urine to indicate in an individual case in which dire
the disturbance lies. The number of crystals of calcium oxala

always proportional to the quantity of oxalic acid in the urine, which reason quantitative tests are often desirable. These may ccomplished by the modified method of Neubauer.

ROBILIN.—A trace of urobilin is a normal product of the urine. onditions of pathological urobilinuria the urine is brown in color,— or dark according to the amount of urobilin. It is moderately eased in the infectious fevers, in most cases of hepatic disease, in ssential anæmias and other blood dyscrasias, after prolonged ether hloroform narcosis, after the use of antifebrin or antipyrin, and hronic lead poisoning. An excess is constant following internal orrhage. It is best detected with the spectroscope; in alkaline e it has absorption bands at F; chemically it may be tested by action from the urine with chloroform, to which Lugol's solution potassium hydrate are then added, when a green fluorescence is luced, which is intense according to the amount of urobilin.

ÆMATOPORPHYRIN is likewise present in normal urine as the faint- race. It is greatly increased after internal or intestinal hemor- e, in some acute febrile processes, and especially following pro- ed use of sulphonal, trional, and tetronal. It is recognized by its rption bands: two faint bands at C–D and D–E, two heavy bands and b–F. It colors the urine pink or red.

CETONE.—A trace is present in normal urine, rarely, however, e 0.1 gramme. It is in excess in many conditions. Fever *per se* produce it; it is constant in the infectious diseases, and in some s of gastro-intestinal disturbances, especially gastric dilatation. It so seen in inanition and marasmus, in the malignant cachexias, in eme primary or secondary anæmia, and after chloroform narcosis. re is often a striking excess in diabetes.

t is probable that it occurs as a result of disturbed nitrogenous abolism, and it is seen typically in conditions associated with rapid e-disintegration, as internal gangrene. There are rare cases of athic acetonuria, and it can be produced by an exclusive meat diet. o determine its presence a few drops of a fresh ten per cent. tion of sodium nitro-prusside should be added to the suspected e, followed by a few drops of sodium hydrate (the urine must be nctly alkaline), when a red color will be produced, which is turned urple by acetic acid.

ABNORMAL SUBSTANCES IN THE URINE.

The only proteid normal in urine is a trace of nucleo-albumen, ch is derived from the epithelium. The proteids which may ap- r pathologically in greater or less amount are serum-albumen, globulin, the albumoses, peptone, fibrinogen or fibrin-globulin nucleo-albumen.

Serum-Albumen.—This proteid is not present in the uri healthy adults living under the best conditions of life, but traces been found in a notable proportion of those whose diet, hygiene conditions are poor. It is generally found in the urine of the born, and often in that of the adolescent, without signs or sym of any disease. In otherwise healthy adults a trace may follow circulatory or digestive disturbances, excesses in exercise, or im erate indulgence in meats without symptoms of malassimilatio may appear in the course of various nervous diseases. Neverth albuminuria should always arouse suspicion, and a diligent s should be made for its cause.

The amount of albumen which may appear in the urine from a trace to three per cent. by weight; what is clinically ter moderate amount of albumen corresponds to from one-half t per cent.; a pronounced amount is over one per cent. Since i worst cases the amount eliminated amounts to no more than f grammes daily, it is obvious that the actual loss of the albumen is of very trifling consequence to the organism.

Renal albuminuria occurs in all forms of nephritis. The alb is present in large quantities in acute and chronic parenchym nephritis, in small quantities in amyloid and chronic inter nephritis. Indeed, while in parenchymatous nephritis albumen a rule, constant and at times present in such quantity that the solidifies on boiling, in interstitial nephritis it may be absent for at a time.

In pyelonephrosis and hydronephrosis the amount, while us small, is variable and liable to sudden fluctuations.

Albuminuria occurs in all febrile conditions and in the infe diseases, due partly to circulatory disturbances, partly to the al blood, and partly to the action of fever and toxins upon the structure. It is seen in all acute and in many chronic diseas the alimentary tract; here again it is toxic in nature. It occu general or local circulatory disturbance, due in the main to c quent disturbance of secretion, although in chronic heart di structural renal change is eventually added. Any form of ac chronic heart disease may show albuminuria.

The most common local conditions which disturb the rena culation are pressure upon the renal vessels, as by a tumor, an placement of a floating kidney. Renal ischæmia, although rarer than arterial hyperæmia or venous stasis, is not uncomm cause of albuminuria, as in cholera and severe diarrhœas. The minuria of pregnancy is likewise to be classed as a circulatory urbance, although intoxication plays a *rôle*.

Transfusion of the serum of a different species is always followed lbuminuria, which occurs in some cases of transfusion of human m or of saline solutions.

In the blood dyscrasiæ, severe primary or secondary anæmia, æmia, scurvy, purpura, and the cachexia of malignant disease or hronic syphilis or tuberculosis, there is generally a small amount lbumen present in the urine, due to slight structural changes in kidney, the result of malnutrition.

There is frequently a transient albuminuria following the convuls of epilepsy or of organic nervous disease, not seen, as a rule, r hysterical convulsions. A similar albuminuria is due to vaso-or disturbances, as in the so-called cyclical or paroxysmal albuuria, which is often reflex to a cutaneous chilling, as after a cold ı. Obviously blood or lymph exuding from the kidney-substance ses albuminuria, and it is thus seen in tuberculosis, malignant dis, suppuration, or stone in the substance of the kidney.

Many drugs and poisons cause albuminuria by arterial hyperæmia irritation of the epithelium. The most common of these are roform, ether, alcohol, carbolic acid, salicylic acid and its salts, osive mercuric chloride, arsenic, iodoform, phosphorus, lead, canides, turpentine, and juniper.

In jaundice and hæmoglobinuria albumen is often present. Exionally it can be produced by excessive hyperacidity of the urine, uric acid *per se* does not produce it.

In all these instances of albuminuria globulin is present: a strict m-albuminuria is an extremely rare condition.

Subrenal or contingent albuminuria is most important from the ical aspect. Inflammation of the mucous membrane of the pelvis he kidney, of the ureter, of the bladder, or of the urethra, hemorge from any of these areas, and malignant or tubercular disease, produce albumen in the urine, in small but variable amounts. In uria, or where lymph or pus is emptied into the urinary tract, umen is likewise present. A calculus in the pelvis, ureter, or lder usually causes albuminuria, but here the phenomenon is likely e irregular. Inflammation or other disease of the seminal vesicles ses albuminuria occasionally, and it is of course seen in spermahœa.

Renal albuminuria must be distinguished from subrenal albuuria by a careful study of the sediment for evidences of nephritis, and of the whole urine for evidences of the special causes of renal albuminuria. (For tests for Albumen, see page 361 *et seq.*)

Globulin generally accompanies serum-albumen, in the pro tion of 1 to 8 : 15. In the albuminuria of amyloid kidney, how and in hæmaturia and pyuria, the ratio of globulin to serum-albu is much higher,—1 to 1.5 : 4 ; thus constituting an important ele in differential diagnosis.

Albumoses rarely appear in an ordinary case of albumin They are, however, seen in the urine of some cases of eruptive fe in osteomalacia, in many cases of bone-tumors, and in some case nephritis and leukæmia.

Very important is pyogenic albumosuria (formerly called pyog peptonuria: it has been shown, however, that the proteids are ge ally albumoses and not true peptones). It is seen in conditions o ternal suppuration,—meningitis, appendicitis, purulent inflammat of the great serous membranes, pneumonia, and gangrene, als tuberculosis and chronic phosphorous poisoning.

PEPTONURIA.—True peptone is rarely present ; the peptonuria been shown to be caused by albumoses which are not precipit by a neutral saturation with ammonium sulphate, the test emplo True peptone survives a triple precipitation (neutral, acid, alka with ammonium sulphate, and has been found so exceptionally it possesses no clinical value.

FIBRINURIA.—The fibrin may or may not be in actual coagula when the urine is voided. It is seen in some cases of profuse hæ turia, in chyluria, and more constantly where there is a coagulat necrosis, as in membranous pyelitis or in tuberculosis of the pe ureter, or bladder.

Fibrin threads should be collected on a filter-paper, washed, solved in hot one-half per cent. hydrochloric acid solution, and solution then treated for albumen. Threads of similar appear have been described in the urine as the result of the action of mi organisms ; these can be differentiated from true fibrin by Weig fibrin-stain (a modified Gram's stain).

NUCLEO-ALBUMEN (mucin).—A trace of this proteid exists in nor urine, but whether preformed or not is yet to be determined. A mal amount never affects the appearance of the urine. A patholog quantity is visible in the urine as a cloud, which settles and draws it the sediment. If the urine be diluted so that the saline concen tion is much diminished, the nucleo-albumen will be precipitated the addition of acetic acid.

A pathological increase is seen in the blood dyscrasiæ, jaund venous renal stasis, and in many local conditions, notably pyelitis, itis, cowperitis, prostatitis (prostatorrhœa), inflammation of the inal vesicles, and calculus anywhere in the urinary tract.

True mucin (a glycoproteid) is very rarely present in either nor- or pathological urine. Mucin reduces cupric sulphate in alkaline ition, while nucleo-albumen, containing an atom of phosphorus in nolecule, is distinguished by the reactions of that element.

Hæmaturia.—A small amount of blood need not color the urine; e amounts produce a pale pink to a deep red color. Accidental naturia is that due to traumatism of any part of the urinary tract o the presence of foreign bodies in the urethra or bladder.

Blood may appear in the urine in any form of nephritis, from ile or infectious hyperæmia to the last stage of degenerative ne- osis; it is most frequently seen in congestion, acute parenchyma- nephritis, and the acute exacerbations of the chronic disease, and larly follows renal infarcts or thrombosis. Blood is irregularly ent in the renal disturbances secondary to heart disease.

In tuberculosis and malignant disease of the kidney, or of any of the urinary tract, hæmaturia is regularly seen, although here phenomenon may vary much as to quantity and periods. The echinococcus cysts of the kidney likewise cause it.

In the blood dyscrasiæ and in hæmophilia there may be inter- ent attacks of hæmaturia; and intermittence is the rule in cystic eys and hydronephrosis. Renal calculus generally causes a mild constant hæmaturia, though in some instances it may be profuse. he rare internal traumatisms of the kidney, as in torsion of a ing kidney, hæmaturia follows the accident.

As a rule, it may be said that, with the exception of the bleeding a ruptured vessel or from tumor or granuloma of the kidney, l hæmaturia never presents clots. Subrenal hæmaturia is very mon. The same causes that apply to the kidney hold true for pelvis.

Stone in the bladder is a common cause of intermittent hæmaturia, the character is not constant. The tumors of the bladder like- present intermittent hæmaturia of variable intensity, though malignant tumors generally bleed more freely than papilloma. ammation of the mucous membrane of any part of the urinary t, and extreme congestion or rupture of dilated veins, may cause naturia.

In the tropics parasites, as the distoma, frequently cause a severe naturia.

The presence of blood in the urine should be considered microscopically, spectroscopically, and chemically. The microscopical pearance will be considered under the heading of sediments.

Blood in the urine presents the absorption bands of oxyh globin, between D and E, which, after the addition of a little monia and ammonium sulphate, are merged into the broad of reduced hæmoglobin between D and E, or of methæmoglobin tween C and D, at D, at E, and at F.

A delicate chemical test is that of Struve: Add to urine a potassium hydrate; then add acetic acid and tannic acid until urine is again acid; if blood be present, a dark precipitate will fo this dried precipitate when treated with ammonium chloride glacial acetic acid will form the hæmin crystals.

By a careful count of the red and white corpuscles following addition to the urine of a little methyl-violet (which tinges the w cells), the simultaneous presence of pyuria can be proved or cluded.

With every hæmaturia there is obviously albuminuria. Whe the albuminuria be entirely dependent upon the hæmaturia is a ter often difficult to decide. The ratio of serum-albumen to glo promises practical assistance in deciding this matter. In a rena buminuria this varies from 9 to 15 : 1. The ratio in the blood v from 1½ to 3 : 1. Obviously, when hæmaturia is the cause of albuminuria the ratio will approach that of the blood. For insta amyloid kidney being excluded, if in a given case the ratio of serum-albumen to the globulin be 9 to 15 : 1, this will show existence of albuminuria independent of hæmaturia. If, on the o hand, the ratio in a given case be 3 : 1, it is likely that the alb nuria is entirely dependent on the hæmaturia. It may be st then, that the more nearly the ratio in any given case approaches blood ratio or the albuminuria ratio, the more positive the suggest naturally, there will be results which fall midway, and in these c the test is negative.

Hæmoglobinuria is the presence of hæmoglobin in solutio the urine independent of the blood-corpuscles. It generally acc panies hæmoglobinæmia.

Hæmoglobinuria may coexist with hæmaturia. It is seen in s cases of severe infectious disease: in burns of wide-spread area some cases of pyæmia, jaundice, scurvy, and fat emboli: and in se poisoning by coal-tar phenol compounds, as carbolic acid and naph by pyrogallic acid, the chlorates, iodine, arsenic, and glycerin; by organic acids, as hydrochloric, sulphuric, and phosphoric; and organic poisons sometimes present in shell-fish. Transfusions of bl

f serum, especially from a different species, can produce it. It is
main sign of the obscure condition known as paroxysmal hæmo-
nuria. No cases of the parasitic endemic hæmoglobinuria seen
imals have been observed in man.

he urine contains, in addition to hæmoglobin, albumen, gener-
hyaline casts, and bilirubin or biliverdin, and quite often there is
diment of amorphous or crystalline hæmin, while in some cases
als of calcium oxalate are present in large quantities. The urine
be alkaline.

he diagnosis of hæmoglobin is made by establishing the presence
emoglobin without red corpuscles or entirely out of proportion to
umber of red corpuscles.

arbohydrates.—Carbohydrates which appear in the urine are
e-sugar, levulose, inosite, maltose, the pentoses, and lactose.

he ordinary glycosuria concerns the glucose group. A trace of
r probably exists in normal urine, but this is never sufficient to
nd to clinical tests.

here is often a transitory glycosuria in cases of acute infectious
se; in many acute and chronic heart, lung, and especially liver
ses; in lithæmia and gout, where it is frequent; in syphilis, and
ophthalmic goitre. This phenomenon is irregularly seen in the
nic derangements of the digestive tract. It is frequent in nervous
ses (apart from the relation of the medulla to diabetes) and in the
natic neuroses, particularly of the abdominal sympathetic system.
ugar may appear in the urine of any form of nephritis, but it is
often seen in the interstitial nephritis of gouty persons. It is
able that an exclusive starch diet or a surfeit of sugar can pro-
a glycosuria in the normal subject, but it will do so more con-
ly in nervous overworked individuals or in those subject to
tive derangements. There is a rare glycosuria of adolescence,
gous to the albuminuria. It occurs in phosphorus, amyl nitrite,
entine, chloral, and carbon monoxide poisoning, and in acute or
nic morphine poisoning. These drugs may cause the appearance
ducing agents, as glycuronic acid, which may be mistaken for sugar.
r is present in the urine of pregnancy and the puerperium almost
equently as albumen. It is, finally, most important as the chief
of the distorted metabolism of essential diabetes.

Experimentally diabetes can be caused by injury to the medulla
ngata or by extirpation of the pancreas, and a renal glycosuria
be produced by the administration of phloridzin (For Qualitative
Quantitative Tests, see pages 364, 365.)

The amount of sugar in the urine may be as high as two and one-fifth pounds per diem, but one-fourth that amount is a heavy suria. The specific gravity of urine usually bears a rough relat the amount of sugar it contains, but exceptions to this are no common.

Large amounts of sugar are practically seen only in true dial in the other varieties of glycosuria the amount rarely reaches tw cent.

Of the other forms of sugar, none have any clinical significa their relations to the urine, except lactose, which not uncommo present in the urine of the nursing mother.

Choluria.—In jaundice the biliary coloring matters are a present in the urine, the salts of the biliary acids seldom. In icteric urine the pigment is bilirubin in alkaline combination standing the bilirubin is oxidized to biliverdin, or to lower compo —changes also which occur in the bladder in cases of cystitis jaundiced subject.

The urine has a yellow-greenish color. Allowed to come in tact with old fuming nitric acid containing nitrous acid, a green forms at the point of contact (Gmelin's test): this reaction can be more striking if the acid be dropped upon a filter-paper through the urine has been filtered. The salts of the bile acids cann demonstrated by clinical methods.

The urine may contain bile in any acute or chronic disease liver or the bile-tracts; it is especially marked in obstruction common duct. It is generally seen following attacks of hepatic even though the mucous membranes and the skin show no tra jaundice; it likewise follows operations upon the liver or the tracts, and phosphorus poisoning. It is very doubtful whether ch dependent on hæmatogenous icterus exists.

Cholesterin is not found in jaundiced urine. It may be se cases of severe cystitis, in tuberculous nephritis, in chyluria, an lowing prolonged ingestion of potassium bromide.

CYSTINURIA.—Cystin in the urine is generally accompanied by verin and putrescin. It has been recorded as a family disease. seen in acute yellow atrophy of the liver, occasionally durin course of infectious diseases, and in the peculiar condition kno idiopathic cystinuria, some cases of which have been shown to b to a specific form of albumen putrefaction within the alimentary It is best diagnosed by the sediment, and, as it may be insolu trace appears as a sediment.

MELANIN.—A trace of melanin or melanogen appears in the in most cases of melano-sarcoma, and also, though less often, in matous processes ; it has been seen in marasmus. The pigment nerally in solution, but there may be a sediment of blackish ules. The urine is dark, but the color may develop only after sure to the air.

IACETIC ACID is seen in the urine under conditions similar to those hich acetone appears, and it is generally accompanied by the lat- It occurs in high fever, in infectious processes, in metabolic auto- ications, and in diabetes. It gives a Bordeaux-red reaction with chloride, but there are many fallacies inseparable from the test, or a reliable estimation a distillation is necessary.

ipuria.—Fatty acids are normal in the urine, but fat probably is The fatty acids are increased in fever and in acute and chronic tic diseases, and are present in great excess in diabetes and in mmoniacal urine of cystitis.

he term lipuria is generally limited to the presence of free fat, at in degenerated renal epithelium, etc. A large quantity of fat cause a whitish cloudiness in the urine, but this condition is rare. often the fat appears as a scum floating upon the urine, but rally it must be searched for with the microscope ; with this ment the fat-globules are easily recognized. If the urine be cted with ether and this evaporated upon a filter-paper, a fat- will be left upon the paper which will blacken with osmic acid.

at may appear in the urine in the last stages of nephritis and in nephritis ; in acute and chronic hepatic and pancreatic disease ; egnancy ; in the cachexia of phthisis and other wasting diseases ; abetes, and in chronic phosphorus poisoning. It is more con- in long-standing suppuration, especially of the bones and joints, alignant tumors of these structures, and in pyæmia and gangrene.

ipuria is constant with chyluria, and is found when a cyst or an ess ruptures into the urinary tract ; it is likewise generally found fractures or operations upon bones.

hyluria is thus named because of the milk-white appearance e urine. The urine in this condition contains albumen, globulin, nogen and fibrin-globulin, blood, fat, tissue-cells, cholesterin, and in. On standing, more or less fibrin always forms, and often plete coagulation occurs. Generally the urine contains these sub- es only at some time of the day, while at other times it is clear.

he cause is almost always the filaria sanguinis hominis, but how arasite brings about this phenomenon is not understood. It has generally supposed that chyluria is caused by an abnormal munication between the lymph-channels and the urinary tract, lymph thus mingling directly with the urine. The constituents of the fluid, however, are not the same as those of lymph: is no sugar in chyluria, while sugar is abundant in the lymph, furthermore the amount of fat present in chyluria far exceeds quantity contained in lymph.

Bacteriuria implies the presence of bacteria in the urine pus either absent or present in small quantity. It is usually th pression of a renal eliminative process, but may represent the ea or the terminal phenomenon of local inflammation. Of one hun and thirty-two cases of bacteriuria quoted by Ellis, the colon ba was the causative factor in seventy-five. In twenty to thirty per of typhoid fever the typhoid bacilli are found in the urine afte second week and may persist for years. The tubercle bacilli, sta lococci and streptococci, bacillus proteus, and subtilis are other teria which are occasionally found.

Bacteriuria rarely produces the symptoms of inflammation previously healthy well-drained urinary tract, though hyperæmia excessive mucous secretion are common expressions of the irrit effects of the abnormal urine.

Symptoms.—The cardinal symptom is the discovery of ba in pus-free urine. The urine when voided is often cloudy and sive. The cloudiness is not removed by acidulation, filtratio sedimentation. There is positive albuminuria when the micro-o isms have been eliminated through the kidneys. The urine is except when it contains the staphylococcus or the bacillus pr vulgaris.

The local symptoms are those of slight irritation, which progress to those of true inflammation.

Treatment has for its end the removal of the cause. Since c pation is a usual cause for colonic bacteriuria, rectal lavage is pa larly serviceable when this organism (the colon bacillus) is found general, urinary antiseptics should be given in small doses and i mentation should be avoided.

Pneumaturia usually denotes a communication between bowel and the bladder; it also occurs from the intravesical fer tation of diabetic urine, and is reported as having been caused b bacillus aërogenes capsulatus.

In emptying the bladder by catheter, air is sometimes introd into the bladder by the manipulations of the nurse in pressing f upon the hypogastric region to expel the last drops of urine. this pressure is removed, the air may be aspirated.

THE SEDIMENTS IN URINE.

ormal urine may be entirely free from sediment; it often con- urates. To preserve urine for examination of the sediment, oform is a convenient agent. An analysis is facilitated by cen- ation.

lood.—The causes have already been given. Upon the study e sediment often depends the diagnosis of the source of the rrhage, and whether or not there is an albuminuria independent e hæmaturia.

ince inflammation or tumor of the bladder-walls, severe and nced enough to cause vesical bleeding, generally renders the alkaline, blood in acid urine points to the ureter or kidney, blood in alkaline urine points to the bladder. To this rule are many exceptions, since there is not infrequently vesical rrhage without alkalinity of the urine, and the renal lesions h cause hemorrhage may coexist with or arise in the course of ic cystitis.

he appearance of the blood in the urine often suggests the source. efore mentioned, profuse hemorrhage with clotting rarely comes above the bladder; when it is renal, worm-like ureteral casts be found.

the red corpuscles are much altered, deprived of their hæmo- (shadow-cells), and especially if they present fragmentation, a origin is strongly suggested. Crenation, however, is largely a cal condition, and does not suggest the source.

the blood comes from the kidney, hyaline and often blood-casts enerally be found after careful centrifugation. In rare cases s of tissue will suggest the seat of lesion.

vesical hæmaturia more of the lining epithelial cells are present when the blood comes from the ureter or the pelvis; the cells t be differentiated, but the degree of desquamation which often s in cystitis is not observed in ureteritis or pyelitis.

o determine whether pus coexists with blood, the red and white scles should be counted by mixing the sediment in salt solution ed with methyl-violet, and employing the ruled slide of the a-Zeiss hæmocytometer. A large excess of white corpuscles d point to a coexisting pyuria, which might serve as a point of osis between renal tuberculosis and malignant disease or other y conditions.

o determine in a doubtful case whether an albuminuria is de- ent upon or simply coexists with a hæmaturia, in the absence of all other signs of renal disease, careful computation and parison of the amount of blood and albumen present are neces Goldberg has thus formulated a method of settling this point. blood is evenly mixed into the mass of urine and the cells are cou with the Thoma-Zeiss hæmocytometer. If there are no more three thousand cells per cubic centimetre and the urine gives an men reaction with nitric acid, the albuminuria is not dependen the hæmaturia, as that amount of blood will give no such reactio albumen. If the number of red blood-cells per cubic millimetre vided into the percentage of albumen (as determined by the Es method), any figure below one-thirty-thousandth means that the men is due solely to the blood; any figure over one-thirty-thousa indicates an independent albuminuria. For example, two cases be given:

1. In a given specimen of bloody urine from urethral hemorr there were one hundred thousand blood-cells in each cubic millim and the quantity of albumen was one-third per cent. The pro tion then stands 100,000 cells per cubic millimetre: $\frac{1}{3}$ of 1 per albumen $= \frac{1}{300000}$: hence an albuminuria due solely to the bloo

2. In the urine of renal tuberculosis, the number of cells, the centage of albumen, and the ratio were thus expressed: 10,000 per cubic millimetre: 5 per cent. albumen $= \frac{1}{2000}$; therefore was independent albuminuria.

Pus.—A few leucocytes are occasionally seen in normal u especially of women. As a pathological condition it is a freq phenomenon.

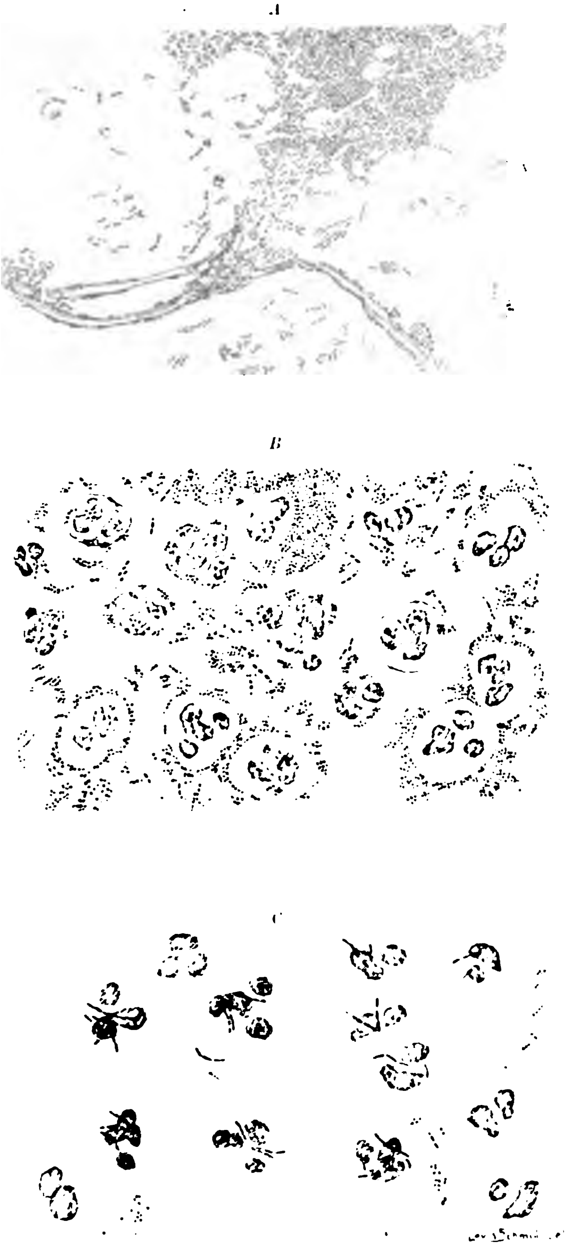
Small amounts of pus may appear in the urine of any cas nephritis, but only in septic nephritis, pyonephrosis, and tuber and malignant kidneys are large amounts of renal pus formed cystic kidneys and pyonephrosis the pyuria is often intermittent may appear in large quantity in a sudden attack of polyuria.

In pyelitis and urethritis suppuration may be free, but it is profuse in cystitis, particularly in the tubercular and obstructive f of the disease. A sudden discharge of pus may mean the ruptu an abscess into the urinal tract,—from the periurethral glands prostate or seminal vesicles, the pericystic region, or the peri tissues.

When a quantity of pus precedes the stream the origin is obvi urethral; when a few drops follow the stream the origin may the prostate gland, the seminal vesicles, or the bladder. As a pyuria due to urethritis clears on standing, that due to cystitis doe

Pus in acid urine generally comes either from above or from b

Fig. 114.



A. Bacteriuria. B. Pyuria. C. Tubercle bacilli in urine.

the urine in cystitis is usually alkaline. This rule
ns. If the pus-cells are much degenerated, this sug-
; renal abscess often presents tissue-fragments, and
often present in renal pyuria. In pyelitis the pus-
s grouped about large cylindrical plugs which come
ducts. The pyuria of cystitis is accompanied by
the lining epithelial cells, more numerous than in
monium carbonate in strongly alkaline urine may
colloid mass, so that pus-cells cannot be recognized.
ne forms a whitish cloud, often stringy, on account
uantity of nucleo-albumen present; for microscopic
may be obviated by the addition of a little dilute
ediment. The pus should be removed upon cover-
by passing through the flame. If stained with the
n, pus-cells generally present neutrophilic granula-
cases of gonorrhœal pus a striking number of eosin-
s are present.

ways be stained for tubercle bacilli. The presence
indicated if pus is present in the absence of bac-
cellular elements. The more carefully and thor-
g is done the more often is tuberculosis found to
uria. The best clinical staining method is carbol-
the cover-glass is smeared with a dilute solution
when nearly dry a drop of the sediment is placed
d flamed; it is then stained for from two to five
ol-fuchsin (to one hundred cubic centimetres of a
ion of carbolic acid add one gramme of basic fuchsin
bic centimetres of alcohol) brought to the steaming
rized with acid alcohol (one cubic centimetre of
ninety-nine cubic centimetres of seventy per cent.
ounterstained with a solution of alkaline methylene
bacilli are red, all tissue and other bacteria are blue.
lli may be found isolated; more commonly they
l grouping. (Fig. 114.) Since other bacilli show this
he surest method is by inoculation into guinea-pigs.
ic organisms a simple watery solution of methylene
basic stain suffices; an especially good general bac-
red by adding half a gramme of French thionine dis-
centimetres of alcohol to ninety cubic centimetres of
ution of carbolic acid; stain for a few minutes. The
most frequent and virulent microbe of the urinary
ne form of short rods with rounded ends, irregularly

grouped and extracellular. It cannot be differentiated by st
from other organisms of the bacillus group.

The typical gonococci exist as reniform diplococci situated
the pus-cells and not stained by Gram's method. In the early
of inflammation they are found as a practically pure culture, i
containing little or no epithelium; exceptionally there is mixed
tion with the ordinary pyogenic bacteria; later squamous and
sitional epithelium is mixed with the pus, and mixed infection
rule, pseudo-gonococci sometimes appearing; these are extrac
and are larger than the gonococci. In the late stages of c
urethritis gonococci disappear, many different microbes then
found in the urine. They may be made to reappear by exciti
acute urethritis.

To determine whether or not an albuminuria depends up
uria, the urine should be added to an equal volume of one per
solution of acetic acid and the pus thoroughly mixed; then a
of methyl-violet is added, a drop is placed upon the ruled slide
Thoma-Zeiss hæmocytometer, and the pus-cells are counted.
another portion of the urine an albumen estimation is made
Esbach's albuminometer; one hundred thousand pus-cells per
centimetre correspond to one per cent. of albumen. If the pu
are thoroughly mixed the results are fairly accurate. The g
defect of the method is dependent on the inaccuracy of Es
albuminometer.

Epithelium.—Normal urine contains a few desquamated ce
pecially in women. The large squamous cells come from the pr
the meatus urinarius, and the vagina. Large cylindrical cells
from the urethra. The epithelial cells of the bladder, urethr
pelvis of the kidney cannot be differentiated in urinary sedim
they are of the same type. Those of the superficial layers are
cylindrical cells of polygonal form, those from the deeper lay
oval, with long processes; they are generally more or less degen
A large excess of these generally points to vesical disease, as the
and pelvis do not shed so many.

The cells from the secreting tubules of the kidney are, as
much smaller than the cells of the subrenal tract, and their
are proportionately larger and more granular. They are pol
in shape, and are seen in all degrees of degeneration. They may
isolated, in groups as shed, or in the form of epithelial casts.
indicate nearly always an inflammatory and degenerative proc
the kidneys. Cylindrical whorls have been described in the ur
cases of amyloid kidney, but they are inconstant.

e.—In some cases of cystitis, following traumatism, of urine, protracted and obstructed labor, or in- roverted pregnant uterus, large particles of necrotic be passed with the urine; not only mucous mem- ind muscular tissue as well. Fragments of vesical na sometimes appear. In renal abscess necrotic led. In tubercular nephritis cheesy detritus, de- nd fibrous and elastic fibres are often present. nes empty their contents into the urine. Dermoid into the bladder and the heterogeneous contents s are seen in cases of recto-vesical fistula.

l Bacteria.—Echinococcus cysts of the kidney y empty into the tract; there will be a gush of a containing a high percentage of albumen, pus, klets of the entozoa. In rare instances small por- concretions may be passed. These attacks may and between attacks the urine may present no e.

he distoma hæmatobium often becomes lodged in ane of the ureter or bladder and gives rise to hæma- ipuria, and discharges its eggs into the urine. The common in the pelvis of the kidney of canines, In a few cases nephrophagus sanguinarius, rhab- males), and psorosperms have been found, accom- ia, which they provoke.

the filaria sanguinis hominis may appear in the losed in blood-clots, and accompanied by a great nd fat. They are well stained by the basic aniline r in the urine only periodically.

the bladder contains no bacteria. In the decom- urine schizomycetes, fermentation-germs, and the play the most active *rôles*. In the decomposition e saccharomycetes are present in large quantities, hyphomycetes after the sugar has been decom- s of cocci, bacilli, and spirilli take part in the am- sition; the most prominent is the micrococcus hains or rows of large cocci. Sarcinæ may appear

TERIA.—The bacterium coli commune, the staphylo- enerally the aureus), the streptococcus pyogenes, useri are the most common pus-organisms. The e from the urethra or from the bladder. Rarely the diplococcus pneumoniæ and the spirillum Obermeieri have found in the urine, particularly accompanying a hæmaturia. typhoid bacillus can be isolated from the urine early in the d and for months, sometimes years, after convalescence.

The pus-organisms may be found in any case of inflammat the mucous membrane of the urinary tract, in acute nephrit renal abscess, in recto-vesical fistula, and in some cases of py erysipelas, and malignant endocarditis.

In genito-urinary tuberculosis the bacilli may appear in the A portion of the sediment should be injected into the subcuta abdominal tissues of a guinea-pig and the animal killed in from to four weeks; from the enlarged lymph-glands or tubercles n point of injection cover-glass spreads should be made and staine carbol-fuchsin (Gabbett method), and cultures may be made glycerin-agar. If the bacilli are not found in the cover-glass pr tions, sections of the tissue should be studied histologically. method should be employed in any suspected case where the cannot be detected in the sediment. Tubercle bacilli may be in the urine of acute general tuberculosis. In rare cases of mycosis of the urinary tract the fungi have been found in the u

The tubercle bacilli must be distinguished from the smegma Unfortunately, this is almost impossible by staining methods

Urinary Casts.—Casts should always be viewed as pathol While it is true that they are sometimes found in urine free from men coming from apparently healthy kidneys, they are pr always due to slight circulatory disturbances, or to malnutrit toxic irritation.

Casts are of the following varieties: hyaline (including cylind granular, fatty, waxy, leucocytic, blood, epithelial, amyloid, an terial. They are thus amorphous, granular, or cellular.

HYALINE CASTS are of a pale, almost transparent appearance, geneous, the edges sharply outlined, and stain well with Lugol' tion and the acid stains. They may be wide or narrow; as they are more narrow in interstitial nephritis, and more wide in chymatous nephritis. Blood-cells, pus-cells, urates, epitheliu bacteria often adhere to them, and they may be slightly gra Hyaline casts are seen in the urine of all varieties of nephritis degrees of arterial and venous congestion, in renal irritation toxins of the infectious diseases, foods, poisons, digestive diseas in auto-intoxication,—for instance, that following an attack of ep They therefore do not indicate an inflammatory nephritis. Cylin are like hyaline casts in structure, but are long and twisted an point; they may accompany hyaline casts in any common in children, and in venous congestion of

AND AMYLOID CASTS are rare. Waxy casts are often broken ends, and are frequently covered with cells fibrin casts are very rare, also the amyloid casts, aracteristic stain-reaction with Lugol's solution or as waxy casts often take a tinge of these stains, equently difficult. These casts always indicate se.

are clinically divided into the pale and the dark. onsist of a proteid degeneration, although fatty de- t-drops may be present in granular casts. They rated epithelium or from epithelial casts. They ganic kidney disease, and are most abundant in ephritis.

s are probably formed by a desquamation of the , which makes a regular mould, with the edges of s of degeneration closely apposed. When the de- eme the cell outlines are lost and a granular cast cur in all varieties of organic renal disease, but chymatous nephritis.

e formed in the tubules by coagulated blood, and n in acute nephritis; they must be distinguished with red blood-cells adherent to them. Degener- ecome granular casts.

IC CASTS are very rare; those which appear as such ne casts covered with pus-cells.

s consist of bacteria massed together, and look like are easily differentiated by staining; they are some- c nephritis and pyelonephritis.

asts of blood-pigment are rarely seen in the urine renal congestion. Casts of urates are quite common, g if they are certainly distinguishable from hyaline urates. In all ammoniacal urine detritus casts ery irregular in outline and appearance.

.—These may appear in the urine following coitus in women). Spermaturia has been noted in tabes inflammation of the skin, and is a frequent sequel sions. The sperm cells are generally entangled in cleo-albumin. Congestion or inflammation of the by interfering with the normal tonicity of the ejaculatory ducts is the usual cause for the spermaturia noted in rasthenics. They are exceptionally accompanied by granules amyloid bodies from the prostate gland. The latter are norm extreme old age; they are small, round, glistening, yellowish-b bodies, which may form the nuclei of stones.

Sago-bodies of globulin are also seen in the urine of case true spermatorrhœa; they are formed and exist normally in seminal vesicles.

CRYSTALLINE SEDIMENT OF ACID URINE.

Urates.—The crystalline sediment of the urine depends upo reaction. In acid urine a reddish precipitate is generally comp of urates; if the color of the urine is pale, the urate sediment is respondingly pale. These urates will pass into solution if the is warmed. They appear as the acid and neutral urates of al normal bases of the urine, and are generally amorphous in They form fine granules, often closely packed in groups, of a yellowish color, which dissolve when the urine is heated, and dissolve upon the addition of an acid, but soon reform as crysta uric acid.

The urates are increased in febrile states, in venous renal gestion, and in concentrated urine. They frequently form ca sodium urate is most often the basis of concretions, but ston ammonium urate occur.

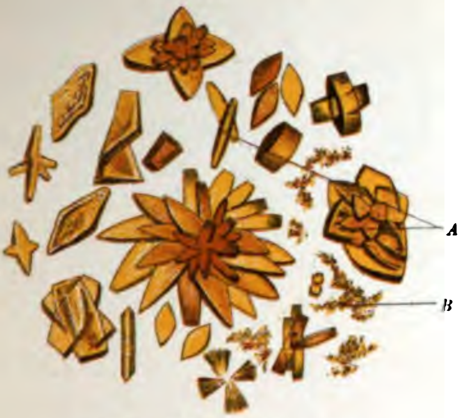
Uric Acid.—The crystals of uric acid appear in many fo rhombic tablets with broken edges, whetstone-shaped, long, ne pointed spars, and prismatic forms (which are the most characte of a yellow color, often cling together in groups. (Fig. 115.) may be colorless. They dissolve upon the addition of an alkali not of ammonia), and crystallize again upon the addition of a mi acid. They also react to the murexide test.

Calcium oxalates appear as colorless octahedral or dumb-bell tals, with many modifications in size and form. (Fig. 115.) are soluble in mineral acids, but not in acetic acid. The numb crystals bears no relation to the amount of oxalic acid in the Such crystals often appear in healthy urine. They are forme excess in idiopathic oxaluria.

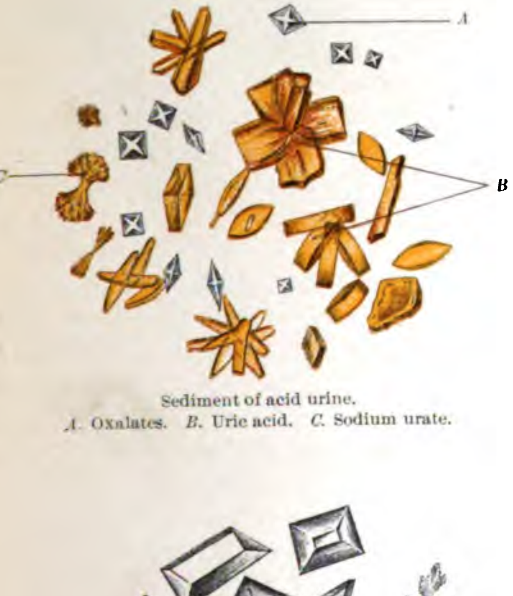
Calcium sulphate appears as long, colorless needles; also as d bells, insoluble in acids or ammonia. These crystals are rarely but occur in the urine of some cases of calculus. Calcium carb occurs also as dumb-bell crystals.

Hippuric acid appears rarely in the form of rhombic cry

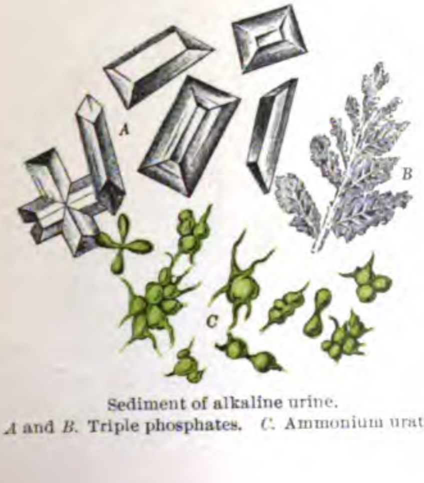
FIG. 115.



Sediment of acid urine.
A. Uric acid crystals. *B.* Amorphous urates.



Sediment of acid urine.
A. Oxalates. *B.* Uric acid. *C.* Sodium urate.



Sediment of alkaline urine.
A and *B.* Triple phosphates. *C.* Ammonium urates.

ia, but not in acids: these crystals follow the inges-
id and of the many fruits which contain it.

æmatoidin crystals are small, yellowish-red, rhom-
ched needles; sometimes, also, yellowish-brown,
s. They are soluble in an alkali or in chloroform,
to Gmelin's test. They are present in some cases
, in acute yellow atrophy of the liver, and in acute
ning; also in severe cases of the infectious dis-

n seen attached to cellular elements, and then sug-
sions of the urinary tract; they have thus been seen
cystic kidneys, cancer of the bladder, renal or vesi-
nd severe toxic nephritis.

ROSIN.—Leucin is generally in solution in the urine;
s round balls of crystalline structure. If a solution
mercury oxydul-sulphite the mercury will in the
be thrown down in the metallic state.

rs as bunches of needles, insoluble in acetic acid,
nmonia and hydrochloric acid. The collected crys-
ssolved in ammonia, recrystallized by evaporation,
ed to Millon's reagent, to which they respond posi-

rosin are found in cases of acute yellow atrophy of
phosphorus poisoning, in internal gangrene, and in
e infectious diseases.

l cases leucin and tyrosin are accompanied by
may appear alone. Cystin crystals look like those
differ in that they are soluble in ammonia. They
acetic acid and alcohol, and polarize light to the

s appear in the urine in the severe bacterial infec-
, and in idiopathic cystinuria. They may form a

alcium and magnesium occur occasionally, and form
emble those of tyrosin and cystin, but do not give

xanthin bases in the urine may form a sediment of
emble those of uric acid, but are soluble in ammonia;
culi.

or neutral urines certain crystals form, which are to
he alkaline sediment. They are triple phosphates,
phosphates, and neutral calcium phosphates; they

form especially when the urine is becoming alkaline. An exce the crystals of triple phosphates in acid urine suggests phospha

SEDIMENT OF ALKALINE URINE.

PHOSPHATES.—The acid or basic phosphates may be amorp small granules. The acid calcium phosphate, a rare form, is pr in the urine of those suffering from imperfect nutrition. Triple phates may be seen in weak acid, neutral, or alkaline urine; marked in alkaline decomposition. They are large octahedral or matic forms, but in ammoniacal urine present innumerable var (Fig. 115.) The basic magnesium phosphate appears as refr rhombic tablets. The neutral calcium phosphate is generally i form of large needles or prisms massed together. These forn intermingle and have endless variations. Phosphates are diss by acids; they commonly constitute the outer coats of near vesical calculi, but may form the entire stone.

AMMONIUM URATES (Fig. 115) appear as round balls of dark often with spicules. They rarely form calculi. Dissolved in acid they recrystallize as rhombic uric acid.

The carbonates of the alkaline earths appear in the uri dark masses of granules; they dissolve with effervescence in acid.

CHOLESTERIN crystals may occur in urine of any reaction, bu seen most typically in alkaline urine. Exceptionally they occ severe cystitis and in chyluria. They appear as flat plates, broken or cut-out corners.

INDIGO crystals may form in the alkaline urine of normal sul but when found in acid urine they suggest an excess of indosulp acid and the allied aromatic compounds of the ether-sulphate s due to tissue-decomposition, such as internal suppuration, gang etc. They appear as fine blue needles and crystals.

TECHNIQUE OF EXAMINATION OF URINE FOR THE USUAL P LOGICAL CONSTITUENTS.

Specific Gravity.—APPARATUS REQUIRED.—A urinometer, su graduated, with a cylinder having fluted walls, which will preve urinometer from adhering to its sides. The form made by Squ convenient. A thermometer, either attached to the urinometer or independent.

The cylinder must be clean and dry, or else its walls mu moistened with the urine to be examined. Insert the dry urino slowly and note that it floats freely in the liquid. When at rest

losed in the urinometer stem the level at which the
enerally, a urinometer is so graduated that 1000 rep-
ty of distilled water, and each chief division on the
d into ten parts.

of a liquid varies with the temperature; hence a
ture at which the urinometer is normal is indicated
he instrument. This is usually 60° F., or 15° C.
tested is above or below this standard a tempera-
ust be made. For clinical purposes the following
und sufficiently accurate.

ee degrees centigrade above the normal add one to
he last order; for every three degrees below the
ne from the decimal of the last order. For exam-
observed = 18° C.; normal temperature = 15° C.;
= 1014; corrected reading = 1015.

ific gravity varies inversely as the volume of urine,
ld also be made for such variation, accepting a given
al. 1200 c.c. is the usual amount, and the total
g from this, should be reduced to such a standard.
orrection is as follows:

$$\frac{\text{rine} \times \text{last two decimals of observed specific gravity.}}{1200}$$

volume of urine excreted in twenty-four hours
c.c.; the observed specific gravity at 15° C. is 1015.

Therefore the specific gravity of the urine is 1018

sults so calculated enable one to compare accurately
from day to day regardless of the variation in volume.
e urine must be fresh if a correct idea regarding the
r alkaline reacting salts is to be formed.

ble indicator for urine is litmus. Into the specimen
introduce two small slips of litmus paper, one red
reddening of the blue slip shows acidity. A bluing
due to a preponderance of alkaline salts. These
e fixed alkalies, most commonly disodium hydrogen
monium carbonate formed by decomposition of urea
bladder or after the urine has been voided. If it is
nate the red color of the litmus will return on
color formed by the sodium phosphate is permanent.

Urine.—Apparatus and Reagents.—A funnel, about
ameter; filter paper; test-tubes, preferably six inches

long by three-quarters of an inch in diameter; Bunsen burner; co glass vessel; pipette.

Concentrated nitric acid; 0.5 per cent. acetic acid; concent acetic acid; potassium ferrocyanide, ten per cent. solution.

Preliminaries.—Filter the urine, making sure that it is finally *fectly clear.* Determine the reaction by means of litmus paper. alkaline, cautiously add 0.5 per cent. acetic acid until the reacti distinctly acid; if originally acid, proceed directly to the following t

Boil about five cubic centimetres of urine in a test-tube. any cloudiness produced by heat. To the urine so clouded a few drops of dilute acetic acid. Phosphates will be dissolved by reagent; albumen is not altered, therefore any remaining cloud is to albumen and urinary mucin (nucleo-albumen) together.

A more delicate test is to add to the urine, acid in reaction almost boiling hot, a drop of concentrated nitric acid. If a clo not produced, add a second drop and again examine in a good Continue this procedure until about fifteen drops of nitric acid been slowly added to the hot urine. A precipitate so forme albumen or globulin, not mucin. It is well to stand the tube for an hour or two and examine at the expiration of that tim cloudiness. If a clouding has taken place heat again, carefully resolution of it indicates an albumose; a permanent precipita referable to albumen or globulin.

Heller's Test.—Into a conical glass vessel of about 50 c.c. cap put a few cubic centimetres of concentrated nitric acid. On the face of the acid float 20 to 30 c.c. of the filtered urine. That the layers may not mix, it is advisable to add the urine from a pip letting it flow slowly down the side of the vessel. A homogen white ring, of greater or less density, will form *at the junction* o two layers if albumen is present.

Common Fallacies.—*Urea nitrate* may, in concentrated specim form a ring, but this is crystalline, not homogeneous, as is the albu ring.

In highly pigmented samples, as in those containing bile or ind there is variously colored zona, not albuminous, bordering the acid.

A faint, waving ring, one to two centimetres above the nitric and which gradually progresses upward, is due to uric acid. farther from the nitric acid layer a band of mucin may be seen.

The pine acids are precipitated by nitric acid, but may be di guished from albumen by their solubility in alcohol or ether.

Potassium Ferrocyanide Test.—Make the clear urine disti

v drops of a ten per cent. solution of potassium
the presence of albumen, globulin, or albumose a
tate will be formed.

gency test an aqueous solution of metaphosphoric
ed by the contact method; for this purpose solid
cid should be carried and a solution prepared when
cid may be used in a similar manner.

mercuric chloride solution made from the ordinary
ve chloride-tartaric acid tablets affords another ready
test. Mercury is indeed one of the most delicate
men, and it has found its most perfect application in
n: hydrarg. chlor. corros., 8; acid. tartar., 4; glyce-
400 (this must be fresh; it spoils in ten days). To
rops of acetic acid are added; it is then filtered; the
to the reagent by the contact method; if albumen is
ing forms. In the application of this method it must
l that it is so delicate that the slightest amount of al-
d by it, and it is therefore best reserved for special
ht otherwise be led by it into too frequent diagnosis
se. A pathological albuminuria which can be de-
's reagent will usually show by the ferrocyanide test.
ls will detect serum-albumen, globulin, and primary
ast reacts also to the deutero-albumoses and to pep-

ive estimation of albumen can be made by the pre-
t and acetic acid, following which the albumen is
with alcohol and ether, dried, and weighed. The
ions by Esbach's albuminometer are no more accu-
btained by careful observation of the intensity of the
bove-given tests.

be precipitated from the other proteids by one-half
ammonium sulphate; this precipitate is washed,
ed; the weight compared with the weight of the total
e the serum-albumen-globulin ratio.

—In testing for albumoses the urine must be fresh,
zymes of the urine or bacteria can produce albumoses
since semen contains albumoses, this must be excluded.
esent it should be removed by simply boiling, and the
ile hot and boiled down. To the hot filtrate ammo-
hould be carefully added up to complete saturation,
ate collected upon a filter and dissolved in distilled
solution is then added an equal amount of a con-

centrated sodium chloride solution and of acetic acid a few drop time, as long as the precipitate forms; the solution is then boile on boiling the precipitate is lessened or disappears, to reappear filtration while hot, in the cooled filtrate, albumoses are present filtrate responds to the biuret test or Millon's reagent.

Sugar in Urine.—APPARATUS AND REAGENTS.—Funnel; filter p test-tubes; pipette; small measuring cylinder; Bunsen burner.

FEHLING'S SOLUTION.—This consists of two solutions, No. 1 taining 34.639 grammes of copper sulphate in 500 c.c. of dis water; No. 2, 175 grammes of sodium potassium tartrate (Ro salt) and 60 grammes of caustic soda in 500 c.c. of water. Pre in separate bottles.

ALMEN'S SOLUTION.—Four grammes of Rochelle salt, 2 gramm bismuth subnitrate, 10 grammes sodium hydrate, and 90 c.c. of Boil, filter, and preserve in a colored glass bottle.

PRELIMINARIES.—Filter the sample before testing. Be sure t is perfectly fresh. The best preservative is a few crystals of finely powdered thymol. Chloroform, formalin, salicylic acid, will themselves act upon the reagents. Always remove album this substance be present, by heating the sample with acetic aci filtering off the precipitate. Then neutralize with a few dro caustic soda or potash.

FEHLING'S TEST.—Mix together equal quantities of Fehling's tions, Nos. 1 and 2, and dilute the mixture with three times its vo of water. This mixture should be freshly prepared each day.

Boil three to five cubic centimetres of the solution in a test- The deep blue color should not change. To the very hot, bu boiling, solution add one drop of the urine to be tested. I presence of a considerable quantity of sugar a red or bright y precipitate of copper suboxide, CuO, will come down immedi Smaller amounts may necessitate the addition of several dro even more before a precipitation occurs. If no precipitate ap after a volume of urine equal to the volume of Fehling's solutio been added, the test-tube being kept hot all the while but *not b* the test is negative. The precipitate must be red or yellow in to indicate sugar.

COMMON FALLACIES.—A flocculent precipitate having a greenish and most frequently due to earthy phosphates, which is not y nor red and not granular, therefore not a reduction due to sugar

A yellow solution, without a precipitate, formed after rather quantities of urine have been added. This is due to reducing stances in the urine which are not, however, sugar.

ich reduce Fehling's reagent just as glucose does.

h may hold in solution a small quantity of copper vent a little sugar from being observed.

h in *boiling solution* reduces Fehling's.

h forms a precipitate with the copper salt. This e.

T, USING ALMEN'S SOLUTION.—Boil 10 c.c. of the sus- the hot liquid add 1 c.c. of the reagent prepared . Boil again; glucose will cause a precipitate of color. If a trace of sugar only is present the liquid r black, and longer boiling is necessary to detect the It is well also to stand the tube aside for at least n another observation should be made. A negative test shows sugar to be clinically absent; a positive further confirmed.

CIES.—Albumen, which by decomposition gives a bismuth, in appearance not to be distinguished from precipitate.

d, which blackens the reagent; also sulphur com- *not sulphates.*

TEST.—Fill a fermentation-tube (a Doremus ureome- th the suspected urine which has previously been a small piece of a fresh yeast-cake. Stand in a velve to twenty-four hours. Any gas which forms upper end of the tube, and, being carbon dioxide, ner presence of glucose which has been fermented control-tube containing yeast and water should be yeast preparation may contain sugar.

TE'S TEST.—REAGENTS.—Concentrated hydrochloric ermanganate, of such strength that when the column -tube is held against the light it is a transparent, oroform.

REATMENT.—If bile is present remove it by adding d, avoiding an excess, and filtering. Iodides must . Accomplish this by the addition of a little silver off the precipitate.

lear urine add 5 c.c. of hydrochloric acid; shake *drop* of potassium permanganate. The urine may r blue. In any case add about 1 c.c. of chloroform, and shake well. The chloroform will absorb the be colored blue, the depth of coloring indicating the n present.

Bile Pigment.—Gmelin's Test.—To a few drops of the filt urine on a white porcelain surface add one drop of fuming nitric A color play, green, blue, violet, red, and yellow, the colors pre ing themselves in rings in the order named, will be observed if is present. *Green* is indispensable; the other tints may be simul by pigments not biliary.

The drop of nitric acid may be applied to a piece of pure Swe filter paper through which the urine has been passed. The rings then appear as above given.

Blood Coloring Matter.—Reagents.—Tincture of guaiacum ozonized ether or old oil of turpentine.

Mix in a test-tube equal parts of guaiac and ozonized ethe turpentine. Float over this a layer of the urine to be tested, avo any mixing of the two layers. A white ring, turning blue, appea the point of contact if blood is present. Heat does not cause disappear. Pus also gives a blue ring, but heat destroys the and the guaiac alone is sufficient to produce it.

Another test is the addition of a few drops of sodium hyd which, precipitating the phosphates, brings down also the coloring matter as a pink or brownish deposit. Warming hasten precipitation.

Heller's test: Add NaOH to the urine until distinctly alka boil and cool rapidly. If hæmoglobin is present it will be precipi with the phosphates and appear as a red or brownish sedi Spectroscopically the absorption bands are generally those of me moglobin, not hæmoglobin.

Ehrlich's Diazo Reaction.—Reagents.—Fifty cubic centim of concentrated hydrochloric acid diluted to 1000 c.c. with wate saturated with sulphanilic acid; a 0.5 per cent. solution of so nitrite.

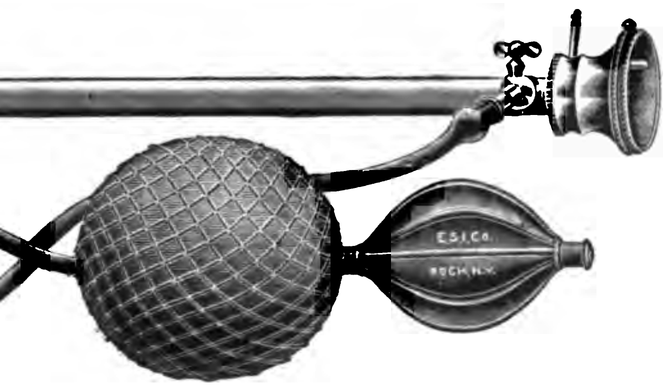
Mix together 40 c.c. of the sulphanilic acid mixture and 1 c. the nitrite solution. To a few cubic centimetres of the urine test-tube add an equal volume of the reagent and shake well. fully float two to three cubic centimetres of ammonium hydrat the surface of the liquid. A sharply defined ring appears at the of contact, yellow if the reaction is negative, a brilliant carmine if positive. As a confirmatory test pour the contents of the tu a large porcelain dish containing water. A salmon-pink color wi seen if the chromogen is present. This is a very delicate reac the pink tinge showing very often when the ring color is indistinc

CHAPTER IX.

INATION OF URINE FROM EACH KIDNEY SEPARATELY.—
PABILITY.—SURGICAL TREATMENT OF NEPHRITIS.

ation of the bladder through the urethra was first
by Dr. Max Nitze, of Berlin. Cystoscopes, as now
n to a little over eleven inches long, terminating in
-fourths of an inch long, which contain the illumi-
an incandescent lamp, and the window through
r can be seen. (Fig. 116.) The shafts of the in-

FIG. 116.



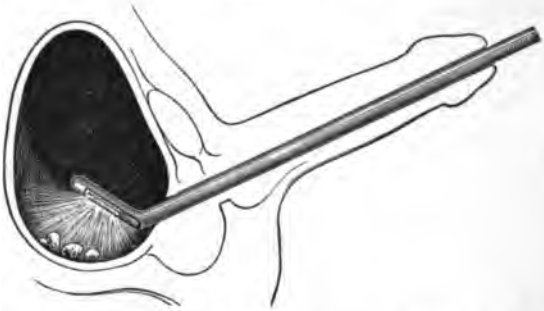
Aëro-cystoscope.

the optical apparatus. The calibre of the cys-
22 F. to 25 F. The beak makes an angle of one
y-five degrees with the shaft, and the window and
usually on the inner surface of the beak. Through
pposite section of the bladder-wall is reflected upon
of a right-angled prism, and thence through the
ument to the eye of the observer. The minute in-
ted and focussed at the ocular end of the instru-
f two plano-convex lenses, is finally magnified by a
-shaped eye-piece.

nd light are sometimes placed on the outer surface
bringing the base of the bladder directly into view.

opes are provided with a channel through which the bladder can be irrigated, thus enabling this viscus to be under varying degrees of tension, and providing the surgeon a means of evacuating the fluid contained in the bladder, sho

FIG. 117.



Cystoscope with the light and window on the outer aspect of the beak.

become turbid, and replacing it with a clear fluid, without ren the instrument. There is also a catheterizing cystoscope, pr with canals through which can be passed ureteral catheters, an cystoscope for direct inspection, of American make, and an op cystoscope, which enables the surgeon to remove small outgr from the vesical mucosa.

In choosing instruments it is well to see that the optical app gives a perfectly clear picture, and that the incandescent lamp good working order. Some instruments are so constructed that s the lamps burn out the tips containing them will have to be s the manufacturer for the insertion of new lamps. It is desirable to secure a number of tips, or to purchase an instrument to w new lamp can be attached by any instrument-maker.

If the surgeon expects to make many cystoscopic examin he will need at least three instruments.

When but a single instrument is used, this should be su with the irrigating apparatus, and should have the window an on the concave side of the flexure. As a rule, it is well to b accustomed to the use of one instrument before trying others.

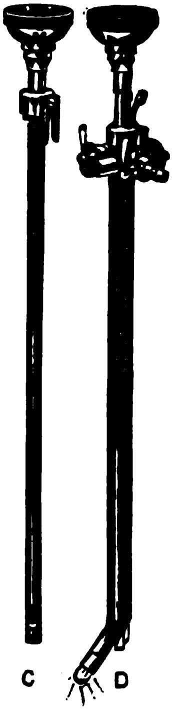
The catheterizing cystoscope should enable the operator to terize both ureters at the same time (Figs. 118, 119, 120), thoug in diseased conditions of the bladder is often impracticable. source of light, a storage battery supplied with a rheostat sho used. An ordinary immersion battery will, however, prove satisfa

Immediately after being used, the shaft and beak of the instr are cleansed with soap and hot water, particular attention

ng the catheterizing canals; the latter should be
a five per cent. formol solution. The instrument is
either in an oven or in a receptacle containing calcium
nally stored in a paraform disinfecting box.

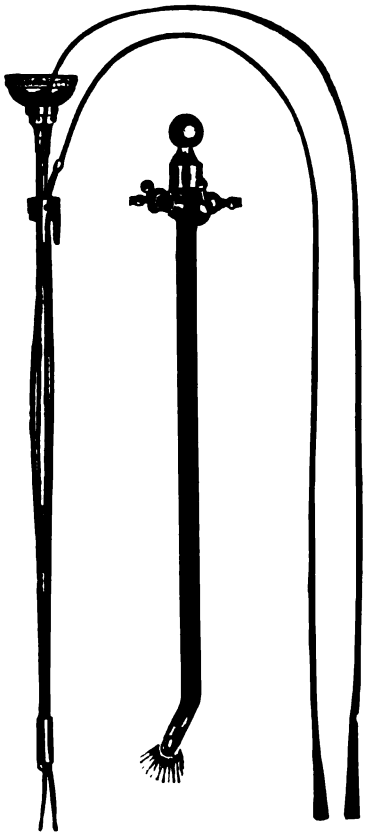
g the Cystoscope.—When required for use, the cysto-
to the battery, and the current is turned on till the
a bright white light; the current is then turned off.

3.



cystoscope.

FIG. 119.



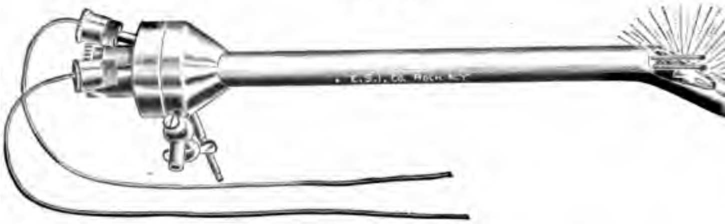
Cabot's catheterizing cystoscope.

instrument is dipped in sterile water or boric acid
dry with a sterile towel, is lubricated with glycerin,
l into the bladder; not till its shoulder has passed
e viscus is the light turned on. To make a satisfac-
of the bladder it is essential that it should contain
es of clear fluid, and that the urethra should be suffi-

ciently capacious and direct in course to admit the cystoscope (
Twenty grains of antipyrin and ten minims of laudanum in an
of water injected into the rectum forty-five minutes before ope
is an excellent adjunct to local anæsthesia.

The aëro-cystoscope is passed into an empty bladder, the

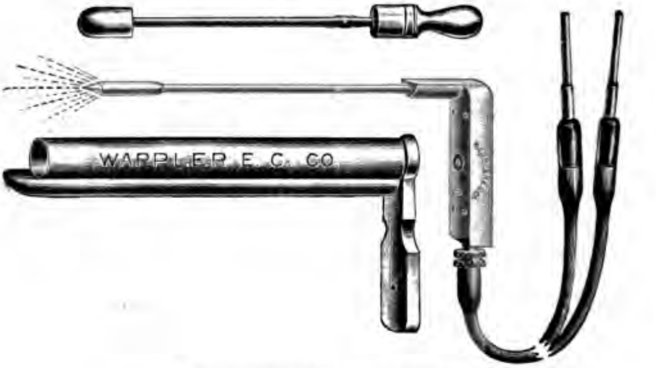
Fig. 120.



Elsner's catheterizing cystoscope.

being in the knee-chest or Trendelenburg position. Local anæ
by means of eucaine usually makes the procedure bearable.
drachms of a twenty per cent. solution of this drug injected th
the catheter or the irrigating cystoscope are recommended by Fe
but a better and safer way of applying this is by means of the
lator: the barrel of this instrument is filled with a four per cent

Fig. 121.

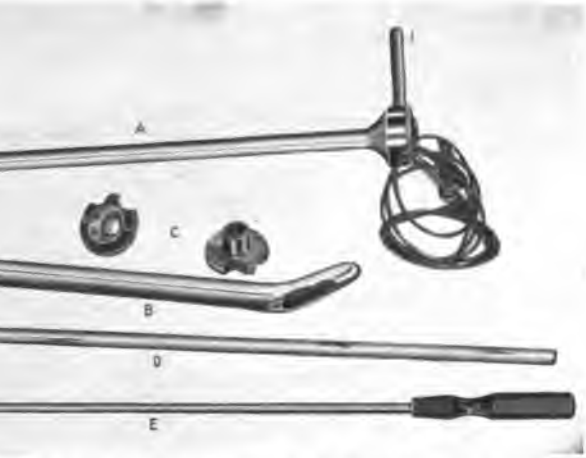


Pryor's cystoscope for the female.

tion of eucaine, the catheter end is then introduced into the u
and as soon as pain is experienced one or two drops are in
When the prostatic urethra is reached, a drachm of the eucaine
tion is injected, the syringe being removed from the catheter as
as is necessary for refilling.

The urine, when it is clear, is the most satisfactory m

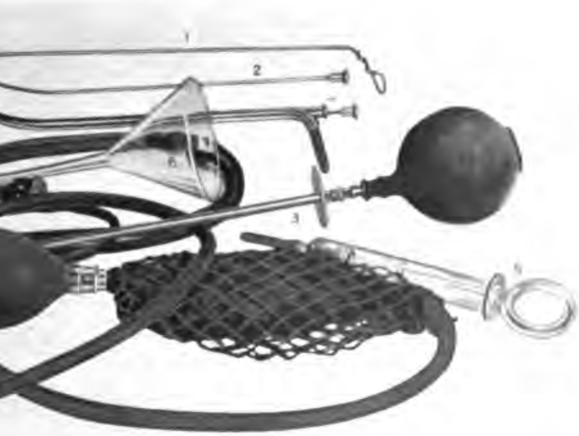
Fig. 122.



pe ; B, female ureter-cystoscope ; C, windows of both ; D, periscope
of male instrument. 1. Handle for electric connection ; 2, catheters
; 3, air-tube and cock.

Bransford-Lewis Ureter-Cystoscope.

Fig. 123.



applicator ; 2. urethral tablet depositor and obturators ; 3. aspirator ;
l extremity for receiving warm air ; 5. syringe ; 6. funnel with tubing

he examination can be conducted. It should be ulate till from five to eight ounces are in the blad- urine is turbid, as from blood or pus, it should be of a Nélaton catheter, and the bladder should be h a one-half per cent. carbolic acid solution or a oric acid solution. In thus washing the bladder it acuate it wholly at any time, as complete emptying ing. When the fluid finally comes away clear, five tiseptic solution are injected and are allowed to re- ler, the catheter being removed. Very little blood is the cystoscopic examination unsatisfactory.

ry examination the patient should lie upon a table s slightly projecting over the edge and his thighs his feet resting on chairs or on a shelf provided for he surgeon sits on a chair or stool between the Vhen ether is given, the lithotomy position is most

pe, having been tested as to its lamp and the proper sual apparatus, is lubricated with glycerin, and is in- as though it were a sound, until the elbow has nal vesical sphincter. This is denoted by the sudden stance, by the ease with which the instrument is ng axis, and by the position of the shaft, which lies th the long axis of the body or even pointing some- The light is then turned on, and the surgeon pro- a systematic examination of every portion of the , as far as practicable, prolonged contact of the lamp cope with the bladder-walls, since there is danger of nless the lamp is supplied with a perforated hood, everywhere surrounded by liquid. In a bladder nded the lamp can be allowed to burn for an naterially changing the temperature of the fluid

of conducting the examination must be learned by s giving the angles at which the shaft of the instru- held are worthless. The instrument can be pushed ndrawn, can be partly or completely rotated, or can limited extent. By these various motions the entire may be seen.

the bladder and the trigonum, as representing the ne to pathological alteration, should be inspected the posterior surface, the vault, and the anterior

surface are systematically explored; finally, the vesical orifice
urethra is examined. Suprapubic cystoscopy through a canul
dicated when the instrument cannot be introduced through the u

In obscure diseases of the bladder or kidneys, when all
means have failed in establishing a diagnosis, the use of the
scope is indicated, provided the bladder can retain four oun
fluid and the urethra is pervious to a 28 F. instrument.

We can reasonably expect to determine by this instrume
presence or absence of tumors, stones, foreign bodies, dive
ulcerations, the extent and character of a cystitis, the condition
ureteral orifices, the secretory activity of each kidney, and the
of blood or pus in the urine.

The cystoscope should not be used till other means o
nosis, except exploratory incision, have been employed and th
dence derived from them has been carefully weighed. Its us
ticularly when there is hæmaturia with sterile urine, should be pr
by preparation for operation when it is probable that this
required. It should be performed as soon as cystoscopic exam
has positively demonstrated that it is indicated.

The surgeon must first teach himself to bring closely int
every portion of the inner surface of the bladder. The ph
bladder, cadavera, and sexual neurasthenics, who are often
fited by prolonged and painful manipulation, offer the best op
nities for learning this part of cystoscopy. Finally comes th
interpretation of what is seen. This requires a wide clinical
rience. In the hands of one without experience the cystosco
comes, in most cases, simply a surgical toy.

Cystoscopic Diagnosis.—The mucosa of the normal bla
straw-yellow in color, with arborescent vessels upon its surfa
slight but distinct trabeculæ. Depression of the shaft of the cyst
and half rotation show the base and the trigonum, suggestin
Fenwick, "a sandy shore;" at the posterior angles of the tri
are the ureteral orifices, each appearing as a depression or slit
in a little ridge of mucous membrane. At intervals of from th
sixty seconds, not synchronously, these ureteral orifices gape a
charge a swirl of urine. Crossing the upper portion of the tri
and forming its base the interureteral line is characterized by a d
often abrupt, transition of color from the straw-yellow of the
bladder cavity to the pink of the trigonum. This line when trace
ally leads to the ureteral orifices. Occasionally, in place of the ridg
is a distinct conical projection marking the ureteral orifice, exhib
motion of recession and protrusion. Failure to find the ureters

generally due to incomplete dilatation of this viscus, ıese ducts being concealed in the folds of the vesical aring when these folds have been obliterated by the f vesical tension. In the vertical type of bladder ılarged prostate, the ureteral orifices when invisible › view by a finger or staff in the rectum. The vesical ıra is examined by withdrawing the cystoscope till the field of vision is occupied by a dark crimson, sharply ıgly contrasting with the yellow glare of the bladder ptible through that part of the window which is not sical neck. The crimson color is due to transmisgh this fold. Its outlines are determined by rotating n case air has entered the bladder during the preliminjection, it forms a round, movable, shining bubble, surface of which the cystoscopic lamp is reflected.

to mistake for a tumor the projection of mucous imes seen about the ureteral orifice. The position and the intermittent jets of urine should prevent he rugæ, if not sufficiently distended, have been misıata; a further injection should make the nature of ficiently clear.

ed on the base of the normal bladder may present a severe subacute or chronic cystitis.

r chronically inflamed bladder the rugæ may closely ıata, particularly if the inflammation is localized in e bladder, as is sometimes the case. Fenwick dethe appearances of certain forms of chronic cystitis ectangular quilting of the bladder, with projections ıs of swollen, almost translucent, mucous membrane pearance of a patch of gelatinous polyps. A similar ase may produce small conical projections, or these y dilated mucous glands or vesicular inflammation. ıed are round, translucent, and small, from the size that of a shot, and are especially numerous over the

eneath the mucous membrane of the bladder causes a yellow, partly translucent, projecting tumor, not The diagnosis will be founded on the presence ion and discoloration of the surrounding mucous

stitis presents features which may render its diagpic examination impossible. The lesions, usually located on the base or the posterior wall, are not unfrequentl ciated with small papillomatous outgrowths. When sharply o ulcers develop, the diagnosis, in the absence of an acute or a c cystitis, is not difficult. When there are general infiltratio thickening of the surrounding mucosa, and especially when is papillary outgrowth, great care should be exercised in form opinion as to the tubercular nature of the lesions from their a ance through the cystoscope.

Diverticula, calculi, and foreign bodies, such as needles an tions of ligature, are readily detected by the cystoscope. This ment, however, finds its most useful place—1, in the diagn bladder-tumors; 2, in determining the question in cases of hæn and pyuria as to the vesical or the renal origin of the blood or

CYSTOSCOPIC APPEARANCES.—In *acute cystitis* the mucous men is intensely red, swollen, and elevated (puffy). Flakes of fibrin seen here and there. Individual larger blood-vessels appear but the fine reticulum of small vessels may be invisible in the œdema. The ureteral eminences are difficult to recognize on a of the general swelling. There may in severe cases be memb exudate.

In *chronic cystitis* the inflammation of the vesical mucous men may be diffuse or localized. The diffuse will appear as gener ness, always more marked about the trigonum and orifices of the u The localized may show patches of intense redness, excoriatio sures, and linear ulcers. In addition there may be noted in ca long standing vesical ulceration areas of contraction, due in cicatrices, in part to muscular hypertrophy.

The localized patches of inflammation are observed in abou fifths of the cases of cystitis. (Garceau.)

There may rarely be noted small red, shiny granulations, s are observed on other mucous membranes. The lymphatic may be visible as small slightly elevated whitish translucent resembling sago grains located beneath the mucous coat which them. The whole surface may present a ribbed appearanc bladder hypertrophy. Various combined lesions are common. inflammation, excoriation, ulceration, patches of contractio hypertrophy exist together.

In all forms of cystitis the severest lesions are located on th terior wall and trigonum, owing to the dependent position o regions and their liability to traumatism.

Vesical ulceration may destroy the whole of the mucous men in patches, revealing a smooth, glistening, pyogenic membran

ar-tissue or granulation surface. Ulceration is most
on the posterior wall and within the trigonum at its

ar ulceration presents lesions generally quite uniform
yellow in color, commonly about the size of a dime,
t or near the ureteral orifices. Its edges are slightly
ed, and surrounded by a pale anæmic zone, set in the
nucous membrane. This must be distinguished from
ontrast to the tubercular lesion, they seldom extend
underlying tissue, though they may manifest such
e base is of a yellow or yellowish-white color and
though occasionally necrotic shreds may be noted on
ey are usually multiple to the extent of two or three
they may be single; they occasionally are very
r the dependent portion of the bladder-wall and else-
a tendency to coalesce, resulting in great destruction
urface, presenting a smooth, glistening, pyogenic mem-
mingled areas of scar-tissue showing as white lines,
redness where the inflamed mucous surface is still

cers result from the irritation of large or rough vesical
he trauma of childbirth.

esions.—In the beginning, *i.e.*, before ulceration has
tubercles appear as grayish, round elevations sur-
eræmic areas. These by coalescence and caseation
This is generally superficial, circular in shape, uneven
yellow in color, and commonly about the size of a
are slightly raised, undermined, and surrounded by a
, set in the deeply injected mucous membrane. This
ished from

y Ulcer.—Fenwick has described a rare lesion of this
undetermined cause, which in many features is com-
c ulcer. It is solitary, is placed near the ureteral
f symptom is hemorrhage, and it results in the for-
ssue. The disease is favored by traumatism, such as
the child's head during labor, rough, unclean instru-
esical retention.

xamination will reveal an extremely sensitive, cir-
irregular ulcer located on the posterior wall of the
in (towards the median line) the ureteral orifice, but
um, about one to one and a half inches in diameter,
kened, elevated edges, and an uneven, necrotic base

extending almost to the muscular layer. There may occur depos
of lime salts on its surface with the production of a secondary co
ulcer on the opposite (anterior) wall of the bladder, and the c
may be exfoliated and voided in the urine. Cicatrization is the
dency, and results in the formation of folds in the mucous memb
resembling carcinoma, especially if the folds become excoriate
ulcerated. It can be distinguished from tubercular ulcer by the
ence or absence of tubercle bacilli as determined by examinatio
the urine, pathologic sections, and guinea-pig inoculation or by
tuberculin test. The tubercular lesion rarely becomes incru
while this is the rule with the solitary ulcer of Fenwick.

The location of the solitary simple lesion is always in a ce
spot as noted, while the tubercular ulcer may be found in any pa
the posterior surface of the bladder, and more rarely elsewhere.
solitary ulcer may be healed with comparative ease.

Other rare causes of vesical ulceration are thrombosis, syp
and trophic nerve lesions. Thrombotic and syphilitic ulceratio
absolutely non-characteristic in cystoscopic appearance.

Trophic Ulcers.—Albarran noted bladder lesions in five out o
cases of syringomyelia. In three there was latent retention, o
which had cystitis with ulceration. The lesions are evidently tro
and the ulcers manifest a marked tendency to perforate, as act
happened in one case resulting in death. The contracting pow
the bladder is impaired early.

The loculate bladder (Kelly) is inflamed, and presents one or
openings leading into small saccules which undermine the bla
wall for a short distance beneath the muscular coat. The pocket
smooth from within, and from their mouths may be noted the e
of retained mucus and pus. They are probably due to a loca
defect of development of the muscular wall leaving a weak spot, w
gives way to the frequent contraction, vesical distention, and hy
trophy accompanying chronic inflammation.

They must be distinguished from congenital supernumerary
ders and from pouches produced by giving way of scar-tissue.
flammation in the loculate bladder is severe and extremely dif
to cure.

Fistulous tracts and sinuses may be noted with the cystos
and extravesical compression or retraction from such causes as p
tumors or adhesions may produce alteration of contour of the ge
vesical cavity.

Cystoscopic Appearances in Diseases of the Upper Urinary Tra
The examination for this purpose has for its special object the s

ifices. The points to be noted are: the presence of heir size, shape, and color; the location of lesions whether or not urine is regularly ejected at certain from each ureteral opening; the relative and approximrine at each ejection; its appearance, and admixture or gravel. The ureteral eminence may be congeni- orifice itself may be entirely closed by cicatricial connant infiltration. It may be partially or completely ere inflammation or obstruction in any part of the act, or from the same cause may be placed in a led eminence.

the subjects of atheroma, the ureteral orifice will arance of a crater-like, gaping cleft, owing to loss of tility.

voided in Cystoscopy.—The ureteral openings may lie nces from the urethral orifice, and may be almost hids folds of mucous membrane, so that the instrument past them while searching. In cases of doubt as ain area contains the ureteral orifice, a finger in the may push the suspected area into better view, and rine. If the urine is invisible on account of transe colored by the previous administration of methylene

d and œdematous folds around the internal urethral be mistaken for tumors or polypi. The former are and opaque.

abeculation caused by the irritation of the beak of the not be mistaken for the constant uniform true trahe whole of the fundus and vertex.

urns must not be mistaken for true ulcers. Incrustas must not be mistaken for calculi nor varicose nod-

IAGNOSIS OF VESICAL TUMORS.—It must not be forgotten e expert the interpretation of bladder-pictures has Tumors have been diagnosed by the cystoscope t be found on opening the bladder. *Per contra*, ere not seen have been found and removed by tomy.

of the tumor, particularly in regard to its compon one or both ureters, should be carefully noted. ressure the intermittent forcible jet from the ureter

The size of the tumor is not easily determined, since this, as through the cystoscope, varies in accordance with the distance o window from the object inspected. Practice with objects of k dimensions will enable the operator to form a fairly good estima

The shape of the tumor, the presence or absence of a pedicl the number of tumors, should be investigated. Information gain direct inspection is not only valuable from a diagnostic stand- but may determine the manner of subsequent surgical intervent

Positive determination as to the benign or malignant natu a growth is often impossible, since, even when the latter is ren by cystotomy, it may happen that this question cannot be settl a microscopic examination has been made. Distinctly pe growths, particularly those presenting long, regular, undu fringes, are usually benign. (Fig. 124, *C* and *D*.) Such gr about the urethral orifice may be detected by the use of th gating cystoscope, the injected stream sweeping the fringes from the window and the light, which they sometimes comp cover.

Sessile cauliflower growths (Fig. 124, *B*) or irregular, ragged lary projections from an ulcerated or indurated surface are indi of malignancy. A localized induration of the bladder-wall, the in which malignant growth often appears, may sometimes be de by distending the viscus to its full capacity. The fluid is then al to escape, the suspected induration being kept under observ Usually such infiltration can best be found by digital examin A diagnosis between carcinoma and sarcoma cannot be made.

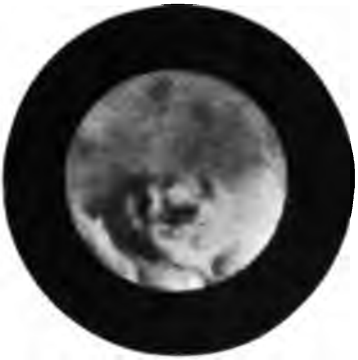
The backward projection of an hypertrophied prostate may s an extension backward of a cancerous infiltration of this gland. wick states that in malignant extension the growth breaks th towards the middle or the base of the trigonum, whilst the vesical outgrowth of enlarged prostate is found near the vesical of the urethra.

The determination of the vesical or renal origin of blood or the urine must at times depend absolutely upon cystoscopic fin Any of the modern cystoscopes, but particularly those design catheterizing the ureters, bring the orifices of these channels into view. If the blood or pus is discharged freely, the irrigatin toscope must be used, otherwise the fluid in the bladder be opaque so quickly that nothing can be seen. By subjecting eac teral orifice to careful scrutiny, the swirls of blood-stained, or i of pus opaque white, fluid ejected into the comparatively clear der-contents will make possible a positive diagnosis.

Fig. 124.

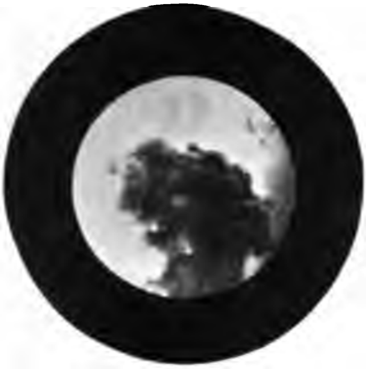
static hypertrophy.
ze.)

B



Showing a widespread malignant tumor from the prostate. (After Nitze.)

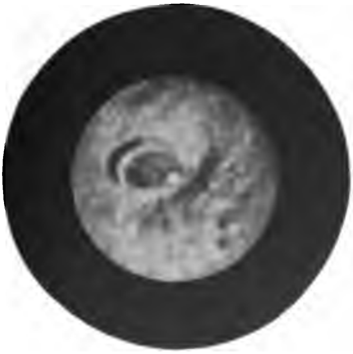
C



us tumor attached to the bladder-wall. (After Nitze.)

villous tumor which
ump is now covered

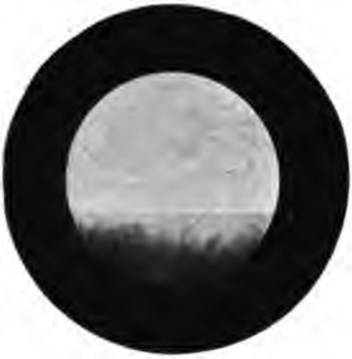
E



An air-bubble which was carried into the bladder by a catheter. (After Nitze.)

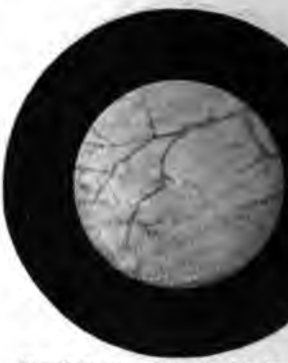
Fig. 125.

A



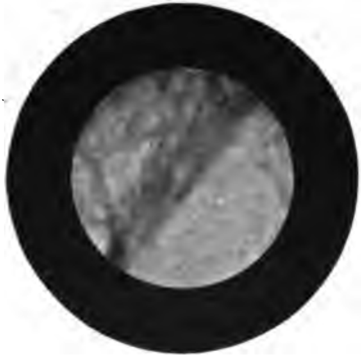
A cystoscopic picture of the normal bladder. The window of the instrument is in the deep urethra. The lower half of the picture shows a translucent fold of the internal urethral orifice with its sharp edge directed towards the upper part which corresponds with the anterior wall. (After Nitze.)

B



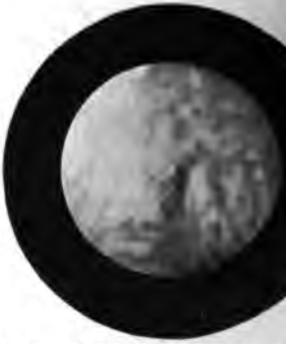
Ramifying vessels on the bladde
(After Nitze.)

C



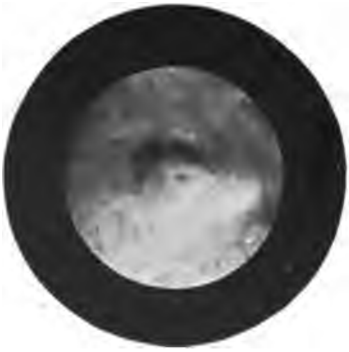
The ureteral orifice on a well-developed ureteral eminence. (After Nitze.)

D



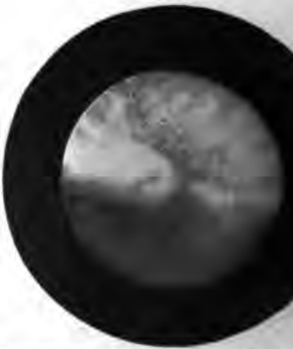
The ureteral papilla is wanting. T
appears as a simple slit. (After

E



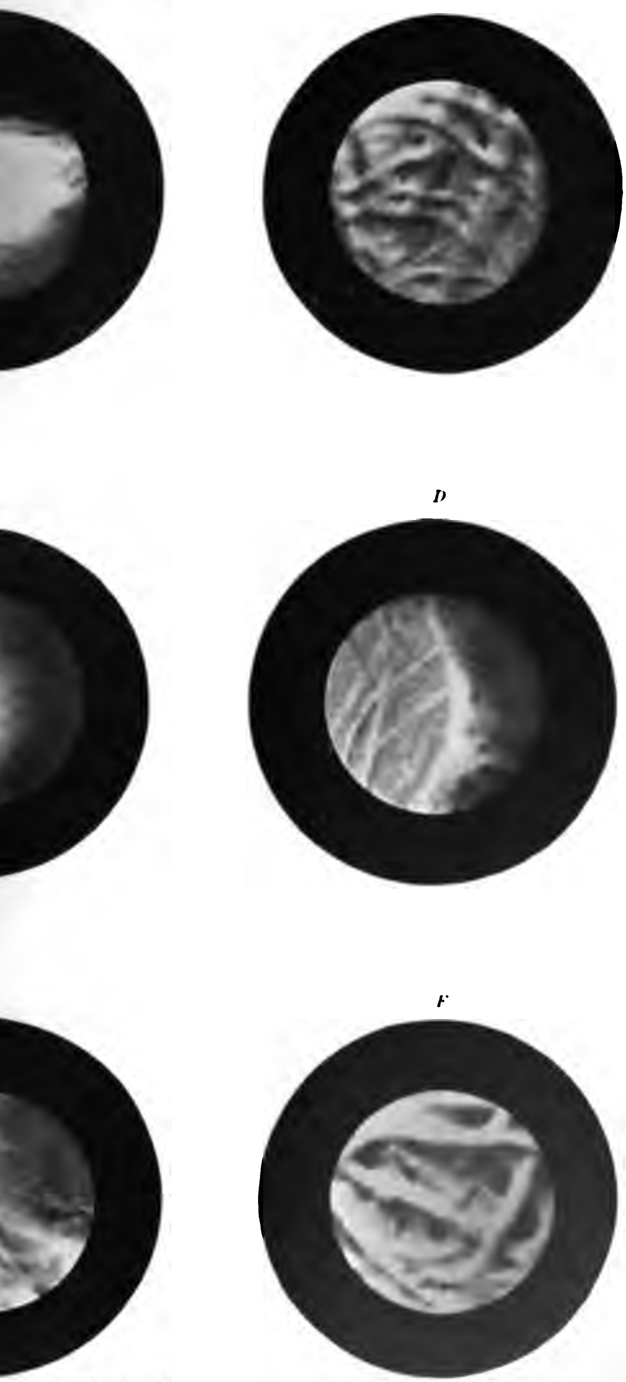
The ureteral papilla immediately before evacuation of the urine. The region surrounding the orifice is raised into a button-shaped projection. (After Nitze.)

F



Well developed ureteral papilla. T
appears as a shallow groove. (Afte

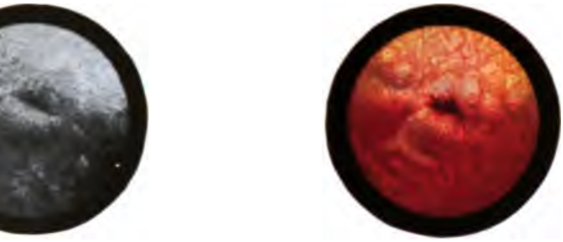
FIG. 126.



er-wall and internal urethral orifice in cases of prostatic hypertrophy. (After Nitze.)

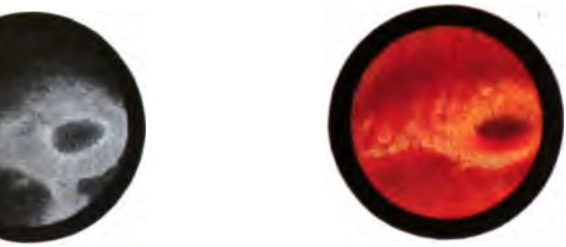
Fig. 127.

A



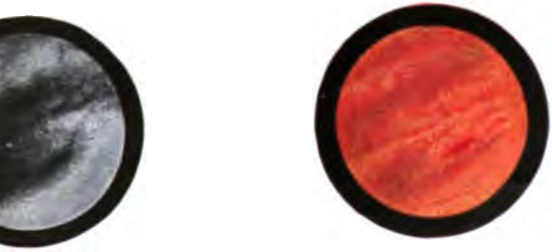
reteral orifice immediately before contraction of the ureter for the emptying itself. The bladder-wall shows diffuse cystitis. (After

B



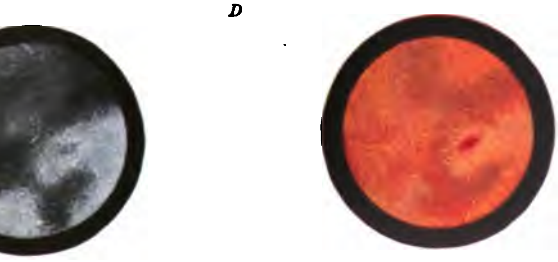
left ureteral orifice in a case of pyelitis with cystitis. (After Casper.)

C



al orifice. The upper part of the field of vision shows cystitis, the lower portion is comparatively normal. (After Casper.)

D



reteral orifice with diffuse cystitis. The bladder-wall appears o vessels are perceptible; but an abnormal redness covers almost ield of vision, only a small area appears to be comparatively little (After Casper.)

n of Urine from each Kidney Separately.—A f the presence, amount, regularity, and certain other ristics of the excreting and conducting power of the act may often be secured from observation of the from the ureteral orifices during cystoscopy. Such facilitated by coloring the urine by administering such ne blue or indigo carmine a half-hour before cysto-

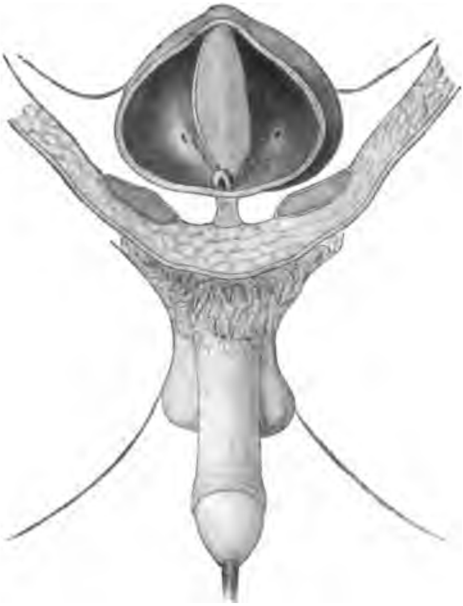
HE KIDNEYS.—The patient is kept in bed for a few amination. A specimen of urine should be saved for e bladder is irrigated with a mild antiseptic solution. e side is then squeezed for several minutes to express e urine is drawn (the instrument may be left in during nd the specimen set aside. The opposite kidney is the same way and this specimen secured.

THETERIZATION.—The purposes of this procedure are: e whether both kidneys and ureters exist and are tive. (2) To secure the urine from each kidney sep- to determine whether or not such products as pus, , tuberculous material, bacteria, and calculous crystals in the upper or lower urinary tract, and if from the , in which of these organs; and to determine the of each kidney. (3) To recognize and locate such tions as torsion and bending of the ureters, valvular cture, ureteral fistulæ, etc. (4) To determine in cer- aracter of the operation advisable. (5) To remove drain the ureters and kidneys. (6) To medicate and ans.

instruments are efficient, among them being those and Tilden Brown; Kelly's straight tubes are gen- in the female. The operation in males often requires , always the greatest gentleness, exposes the patient of traumatism to the bladder and ureters, and the infection from the bladder upward.

ion and technique of ureteral catheterization is iden- of cystoscopy up to the point of introduction of the s. The aseptic technique should, if possible, be even e ureteral orifices are often difficult to find. The is the most important landmark; in the vertical type ff in the rectum may elevate them to view. The methylene blue before operation will color the urine isible when ejected from the ureteral orifice. The position of the lens should be as near as possible to the orifice. The catheter, having been previously sterilized and t make sure that its lumen is free, is made to enter the ureteral and is passed upward by a rotary motion for a distance of ab centimetres (two to two and one-half inches) if catheterizatio only purpose. For exploring and irrigating the ureters and ren it may be carried on to the kidney pelvis. With each catheter in the appropriate ureter, the cystoscope may be carefully wit so as not to disturb the catheters, and the external ends tied i in the same manner that filiform bougies are secured; or the ment may be left in s held for the one-half hour necessary for urine to accumulate glass tube or bottle int each catheter empties operation should b formed at the time when secretion is fr it is well to administer draught of water a co hours before. It of quires several minu urine to flow even wh instruments are posit the ureters, and then pears in drops at t of about five-tenths centimetre (seven t minims) per minute each normal kidney. enough urine is secured, the catheters are carefully withdrawn a time, the urine from each kidney is labelled, and the bladder irrigated. Such drugs as salol, boric acid, and urotropin are indicated after intravesical instrumentation.

Fig. 128.



Cathelin's urine separator.

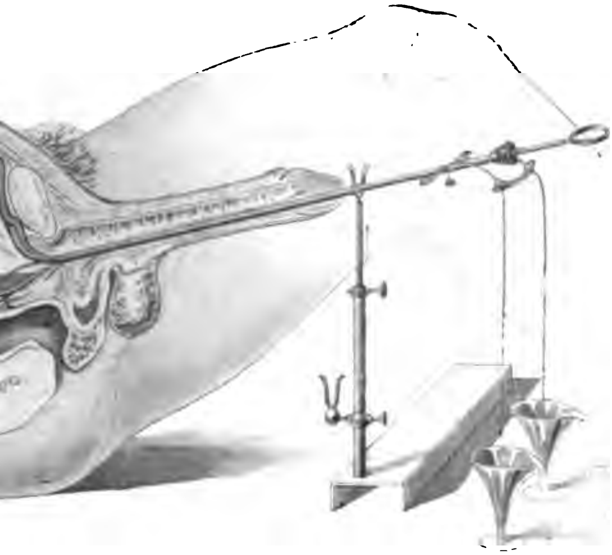
Ureteral catheterization in women presents much less difficu in men. The technique is similar. Kelly advises the knee-che tion, Webster the exaggerated Trendelenburg.

The catheterizing female cystoscope may be employed, straight urethral tube, the light being reflected either by mea head mirror, or by a small electric light fitted in the tube.

SEGREGATION OF URINE.—This has for its sole purpose to sec

om each kidney. Among the instruments employed
s, Luys, and Cathelin. The latter is most efficient.
egregator consists of a cylindrical tube (calibre 25 F.),
ous sizes, shaped at one end like a short beaked
ft is divided into three compartments: The central
tached at the handle to a wheel and at its vesical
rubber membrane, set with a delicate steel spring;
artment carrying a catheter. The intravesical end
is so grooved that when the membrane is projected
, it will maintain a vertical position. It thus divides

FIG. 129.



Cathelin's urine separator.

posterior urethra into two entirely separate lateral
28), each chamber receiving urine only from its
ney. The instrument may be sterilized,—each part
vhen mounted must be lubricated. The patient is
zontal posture on either a table or a mattress ren-
oard to prevent sagging, and the bladder irrigated
r adrenalin solution until the fluid returns clear.
city should be determined by slowly injecting fluid
ire to urinate is noted. This fluid is now withdrawn,
nount (two or three ounces) of fresh clean solution
ved to remain to start siphonage, and to make sure
each catheter is open. The instrument is inserted

exactly as a sound is passed, and after the beak enters the bla
is gently withdrawn forward until it is felt to impinge tightly
the symphysis pubis. By means of an arrangement at the ou
the diaphragm is opened; the flexible septum adapting itself ac
to the contour of the bladder. The catheters are now adjust
the total, or perhaps a little more than the measured quantity
which was allowed to remain, is withdrawn, proving the cath
be properly placed, their lumens clear, and both chambers
The outer end of the shaft is supported on a rest in such a pos
to allow good siphonage into the small flasks into which each
empties. (Fig. 129.) From ten to thirty-five minutes are
to secure enough urine for examination. The instrument afte
properly adjusted should not be disturbed. If, however, the ca
become clogged, they may be opened by gently injecting severa
of water through. Great care must be exercised not to set
the smallest amount of bleeding by the instrument or blo
appear in both urines. The membrane must be accurately
to the inner surface of the bladder. If not tight enough the ur
be mixed, if too tight pain even to the extent of tenesmus will
duced. The same effect will be produced if the ends of the
are allowed to irritate the vesical mucous membrane, and if the
are above the level of the fluid, the urine will fail to flow
method is inapplicable in certain cases with enormously hypert
prostate, or in any condition producing marked irregularities in
of the vesical wall, and while it produces little pain in a non-s
bladder it is intolerable in acute cystitis. As to its efficiency in p
selected cases, there is abundant evidence. It is not sufficiently a
for a bacteriological differentiation of the urine.

Determination of Renal Capability.—The questions
solved are: (1) What is the excreting power of the kidney
What is the probable chance that the remaining kidney may
plish physiological compensation in case its fellow must be re

To solve these questions involves a study of the combine
tional power of both kidneys together, and in case of conte
radical treatment, of each organ separately. The chief physic
tion of the kidneys is permeability. The most conspicuou
function of these organs is to excrete from the blood the end p
of metabolism.

Various tests of these functions and of the total renal pow
been applied with more or less practical results; among wh
the simple dilution test; the methylene blue test; the phloridz
and cryoscopy of the blood and urine.

Test of Renal Function.—This has for its purpose the permeability and excretory power of the renal er. The points considered to be of value are: (1) earance of increased excretion after the ingestion of of water. (2) Relative delay and difference in the by each kidney separately. (3) Relative proportion centration in the urine from each kidney separately cryoscopy. The patient after emptying the bladder a large quantity of water at one time; and for sev- ng, the urine, as secured from each kidney separately, examined. This necessitates ureteral catheteriza- our or every hour, or the presence in the bladder of nuously; and must in every case be governed by a

nstrated by this method insufficiency long before it by any other means.

ne Blue Test of Renal Capability is based on the al structures to transform and eliminate this coloring taneous administration. A sterile solution of methy- ntigrammes), or indigo carmine, is injected subcuta- nsing and evacuating the bladder. If the kidneys be is colored in half an hour, becoming more markedly d fourth hour, and remaining at its maximum for two Thereafter the color gradually fades till its entire about the fortieth hour. Delayed and prolonged to impaired renal permeability.

in Test has for its basis the power of normal kidneys within a certain time after the subcutaneous admin- dzin. This is dependent upon the transforming and nd upon renal permeability.

g the bladder five milligrammes of a sterilized prepa- zin with an equal quantity of sodium carbonate, are cutaneously. Normally, sugar appears in the urine in Within a half-hour after administration, the normal ain forty-five one hundredths per cent. sugar and at cond half-hour about six-tenths per cent. less. The bsent at the end of four hours. In serious renal dis- ce of the sugar is delayed, and elimination is prolonged, l in quantity or absent. Quantities of three-tenths per n the first half-hour indicate insufficiency. The drug el reports cases in which sugar did not appear.

The freezing-point of blood and urine is dependent on its molecular concentration. This molecular content is mainta a more or less constant point largely through the selective and native functions of the kidneys. Upon this basis has been su the freezing test as an index to renal capability.

The urine to be examined for unilateral renal capability obtained from each kidney separately; for determining total ciency in bilateral kidney disease with a healthy bladder, the urine may be used. The blood may be obtained from one superficial veins at the elbow, by means of a small trocar amount of either fluid required is from ten to twenty cubic cent (two and five-tenths to five drachms). It must always be ke perfectly clean vial or test-tube, and unless examined fresh sh kept in a refrigerator to prevent decomposition.

Kümmel from a study of two hundred and fifty cases dete that, in healthy individuals free from kidney disease, the freezin of the blood is constantly between 0.55° and 0.57° below zero - C. being taken as the normal. That of the urine is quite varia tween 1.2° and 2.3° C. below zero. He concludes that a freezin for the blood lower than 0.58° or for the urine lower than 1.0 zero is indicative of renal insufficiency.

The technique of these so-called accurate tests is intrica subject to many sources of error, even in skilled hands. Th ridzin test gives greatest promise of usefulness.

Surgical Treatment in the Presence of Renal Insufficiency.—N case of renal insufficiency indicates impending kidney breakd uræmia; nor does normal function in these organs necessaril antee against such occurrence. Disease in one kidney often suspension of function directly in the organ affected and reflexl fellow. The severity of such effect is not always in proportio severity of the lesion.

All food necessitating extra work on the part of the kidney excluded; in many cases the diet should be limited to milk. bed, free purgation, a warm room free from draughts, in som diaphoresis by drugs and occasionally hot packs or vapor ba demanded. Cardiac and vascular tonics, particularly digitalis, its relaxing effect, nitroglycerine are useful. The urine must dered bland, all sources of irritation and obstruction remov perfect drainage of these organs maintained. It has been man conclusively demonstrated that thorough bladder-drainage b eter is one of the most potent factors and often sufficient in i restore impaired renal function. Nitrous oxide anæsthesia whe ticable should be employed during operative procedures in pre oroform; extra precautions against shock should be ıd hypo-dermoclysis of hot normal salt solution are th kidneys are the seat of extensive disease, double preferable to single nephrectomy combined with nehe disease is unilateral and nephrectomy is indicated ıary nephrotomy on the diseased side will allow the o undergo compensatory physiological hypertrophy, so ly the diseased organ may be removed with greater nephrectomy with the opposite organ already crippled ally, the sudden extra work thrown on the opposite n total cessation of function.

reatment of Nephritis.—The signs of inflammaey having for their basis some localized etiologic factor, bscess, renal mobility, etc., present certain indications vention and are discussed in their appropriate places. right's disease, dependent upon extra renal systemic panied by the evolution of a different morbid process ıeys and in the structures throughout the body, parirculatory apparatus.

gic effect of such morbid changes is renal insufficiency. marked by auto-toxæmia, hydræmia, general anasarca, ırax, high circulatory tension with cardiac hypertrophy, nt compensation and myocardial degeneration, ending of blood-pressure to circulatory failure.

te anatomical effects of renal decapsulation as proposed he treatment of nephritis, are the release of excessive nsion, and more or less laceration of the renal cortex. e diffuse nephritis, the large white kidney of chronic disease, and in the engorgement accompanying acute the course of any form of chronic nephritis, the organ ands upon incising the capsule.

effects have been conclusively demonstrated clinically, and by a few autopsies in the human subject. A new capsule is formed from the connective-tissue cells lar structure and surrounding cellular proliferation. becomes dense, and intimately related to the renal a large measure devoid of blood-vessels, and shows ıicating anastomotic branches. The organ becomes l the clinical phenomena of a rapidly progressive, conen kidney are instituted. Such phenomena become lly within a few months. About seventy-five per cent. ortality is due to diffuse nephritis.

Puncture of the kidney and capsular incisions produce a effect in relieving tension, though less marked than complete de lation. The damage to the cortex is less severe, and the newly cicatricial capsule less regular in structure. In progressive this form of local depletion is distinctly indicated.

The organ may be decapsulated rapidly under nitrous oxid ether, or chloroform anæsthesia, in some cases with the aid anæsthesia by the infiltration method. The technique is denudation. (See page 535.) Ante- and post-operative tre must be rigid to the minutest detail, guarding particularly culatory apparatus and against pulmonary complications, œdema. The most rigid aseptic technique must be employ the water (urine) soaked dressings must be changed sufficientl to maintain a dry wound.

CHAPTER X.

INJURIES AND DISEASES OF THE BLADDER.

—The bladder, when normally distended, holds about id. Provided its walls are healthy, the urine may be ut risk of injury till twice that quantity has accumu-from chronic obstruction there is constant, slowly in-esical tension, the bladder may become greatly dis-ıg over a gallon of urine. When empty, or moderately bladder lies within the pelvis, between the posterior pubic symphysis and the rectum. As it fills, its upper om the pelvis and can be felt on abdominal palpation, ward and is closely applied to the belly-wall. As ten- the upper posterior wall bulges upward, and may be the umbilicus.

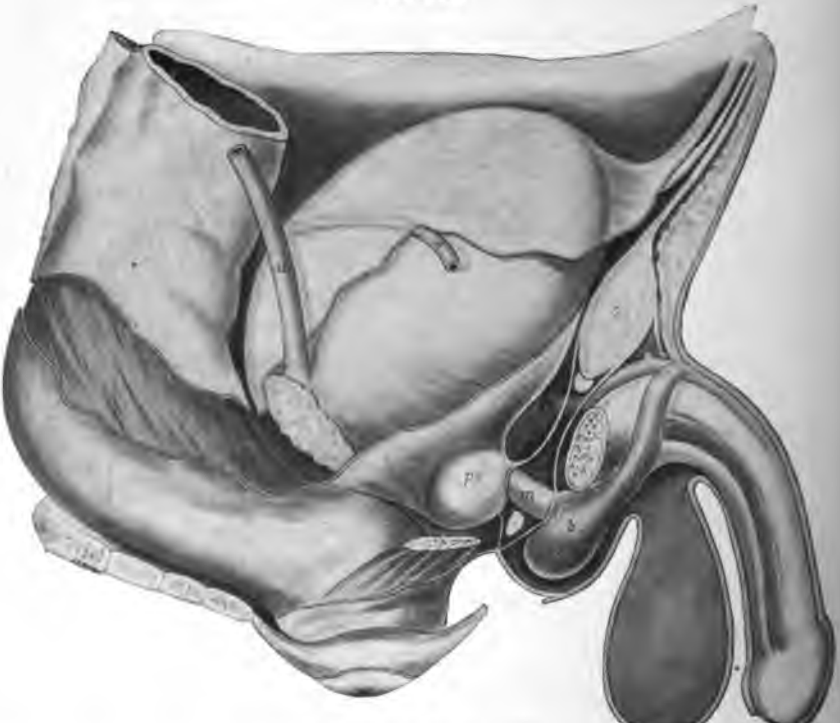
r fundus of the bladder, that portion lying between the ›n of the vesico-rectal peritoneal fold and the vesical r and more capacious than the summit. The vesical est portion of the bladder in the erect position, is placed a quarter inches behind and slightly below the middle mphysis ; in children, this orifice is on a level with the the symphysis, the bladder in them lying much higher ı.

portion of the bladder is freely movable ; its base is xed. It is held in place by the recto-vesical fascia, by ıuscular and fibrous attachments to the prostate, by ıd the obliterated hypogastric arteries, by its vascular ıd finally by ligaments derived mainly from the reflec-lvic fascia (true ligaments) and from the peritoneum).

ıs, a fibro-muscular cord, and the obliterated hypogas-ss from the summit of the bladder to the umbilicus. s of the pelvic fascia hold the neck and base of the ition. The anterior or pubo-prostatic ligaments from he lower portion of the pubic symphysis fix the pros-the anterior part of the bladder neck ; the lateral liga- the prostate and the lateral border of the bladder e ligaments or peritoneal folds are the superior, covering the urachus and the obliterated hypogastric arteries from the umbilicus to the vesical apex, the lateral, reflected from the iliac fossæ to the bladder sides, and the posterior, containing the ureters and hypogastric arteries and bounding the recto-vesical fold.

Peritoneal Covering of the Bladder.—The peritoneal covering of the urachus and the obliterated hypogastric arteries passes directly to the bladder, investing its posterior surfaces from the apex to the posterior extremities of the seminal vesicles and the vesical extremities of the ureters. It is continued laterally to the position of the obliterated hypogastric arteries, passing backward as it descends to the recto-vesical cul-de-sac, and covering a portion of the vas deferens. Posteriorly, the peritoneum is reflected from the bladder to the rectum, forming the recto-vesical pouch. This pouch is usually more than three and less than four inches from the anus; exceptionally, the vesical peritoneum may descend as far as the prostate, and would then be less than two inches from the anal orifice.

Fig. 130.



Side view of pelvic viscera.

adder is empty the peritoneum lining the anterior
nds as far as the upper border of the pubis, and is
is level to the vesical apex. As the bladder becomes
eritoneal reflection is lifted upward, and the anterior
omes accessible to operation by suprapubic incision
of entering the peritoneal cavity. (Fig. 130.) When
oderately distended and is further elevated by rectal
eritoneal reflection may be raised two inches above
r of the symphysis.

the parietal peritoneum is adherent to the symphysis.
prapubic cut must necessarily open the general ab-
There is no means of determining the presence of
lous condition before operation: hence the danger
n suprapubic puncture or aspiration.

THE BLADDER.—The mucous membrane of the blad-
of flat epithelium based upon deep layers of cylin-
is of a yellowish color, exhibiting plications which
stention of this viscus. The submucous fibrous tis-
tic fibres, and by its loose attachment to the under-
ables the mucous membrane to accommodate itself to
imensions to which the bladder is constantly subject.
the mucous membrane is applied directly to the sub-
and slight papillary outgrowths are sometimes seen;
dimentary glands are found.

r walls of the bladder are arranged in three layers.
tudinal layer contributes fibres to the formation of
ical ligaments. Through or between these musculo-
uli pass the anterior vesical veins to join the plexus
he middle layer is composed of circular fibres com-
n the bladder. These are thickest about the urethral
the internal vesical sphincter. The inner layer is
gitudinal fibres passing from the apex to the neck.
posing this layer are grouped in bundles or fasciculi,
se, forming a coarse net-work and producing the
iculation of the inner surface.

ION AND INNERVATION.—Blood is carried to the bladder
the internal iliac arteries. These are the superior
the apex and the lateral surfaces and deferent canals;
al, supplying the base of the bladder and the seminal
ferior vesicals, often from the middle hemorrhoidal,
rostate, the seminal vesicles, and the trigonum; and
icals, small and variable, derived from the internal

iliac or the obturator. These blood-vessels penetrate the m
coats of the bladder, forming a submucous plexus from wh
epithelial capillaries are given off.

The veins of the mucous membrane, having penetrated th
cular coat, form a superficial plexus, made up of large, freel
tomosing, valveless trunks, usually running longitudinally.
anterior vesical veins pass into the pubo-prostatic plexus (ple
Santorini), situated just beneath the symphysis to the right a
of the median line; the lateral veins, particularly volumino
numerous, empty into the vesico-prostatic plexus. The po
veins, also large, pass into the vesico-prostatic plexus or s
plexus. The pubo-prostatic, the vesico-prostatic, and the s
plexus anastomose freely, and practically form one series o
vessels, which is emptied by all the veins lying near at ha
cluding the hypogastric, the ureteric, the hemorrhoidal, the i
pudic, the obturator, and the spermatic.

The lymphatics of the upper two thirds and lower anterio
and neck of the bladder drain into the external iliac ganglia, th
the posterior third into the hypogastric or presacral glands.

The nerves of the bladder are derived from the hypogastric
and from the anterior branches of the third and fourth sacral

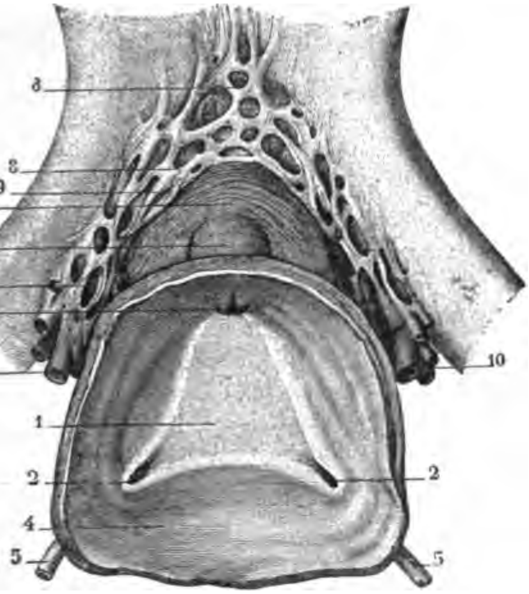
At the bladder base lies the trigonum, presenting a smoo
surface, in the form of a nearly equilateral triangle, each side of
is about one and a quarter inches long. The angles corresp
position to the internal vesical orifice and the two slight proj
or openings of the ureters. The triangle may be distinctly o
by perceptible ridges passing between the two ureteral op
and from these to the internal vesical orifice. (Fig. 131.)
ridges represent a reinforcement of the vesical and ureteral m
designed to preserve the valve-like action of the ureters and t
them closed against back pressure from the bladder. The reg
the vesical triangle is indicated on the outer surface of the blad
the position of the seminal vesicles. When these are norma
veloped, a line joining their posterior extremities indicates th
of the triangle; the point where the bladder-wall merges in
mid-portion of the prostate indicates its apex.

The trigonum and the vesical neck are more abundantly su
with blood-vessels and nerves than are any other portions
bladder.

It follows from the position of the bladder that it is wel
tected from direct traumatism, and that it is accessible to explo
by combined rectal and suprapubic palpation. Its abundant

quick healing of surgical or accidental wounds when
s favorable for healing are present. The superficial
pithelium with which the mucous membrane is pro-
ainst absorption from the bladder as long as the epi-
s healthy and unbroken, thus protecting the system
ng by toxic substances eliminated with the urine and
ssues locally against infection. The loose attachment
membrane to the underlying muscular tissues and the
the muscular coat prevent extravasation of urine after

FIG. 131.



appey.) **1, surface of the triangle ; 2, 2, posterior angles and ureteral openings ;
enting the urethral opening ; 4, slight pouching behind the triangle ; 5, 5, ter-
e ureters ; 6, upper portion of the bladder sphincter ; 7, constrictor muscles of
8, 8, plexus of Santorini ; 9, 9, vesico-prostatic plexus ; 10, 10, cross-section of
where they reach the lateral portion of the base of the bladder.**

ll bladder, the opening, on withdrawal of the needle
ing valvular by the sliding of the tissues. The great
at the base of the bladder and the many large veins
surface, together with the free intercommunication
e pelvic veins, explain the frequency of dangerous
g in bladder surgery. These facts also show how
ffect upon the bladder is exerted by any cause, such
, producing pelvic engorgement. The particularly

generous innervation and vascularization of the trigonum a
bladder-neck explain the greater pain and reaction from inflam
or manipulation of this part of the viscus.

MALFORMATIONS AND MALPOSITION OF THE BLADDER.

The bladder may be multiple. Its walls may be absent in
or in part, may be hypertrophied, atrophied, or herniated
urachus may remain patulous.

Multiple bladder, in the true sense of the term, is an ext
rare deformity. Usually there is a single bladder with a
dividing it into two portions, which may or may not comm
with each other, a ureter opening into each portion. More fre
it is a sacculated bladder. Sometimes the apparent anomaly
to the enormous dilatation of a ureter.

When the bladder is really multiple, as, for instance, in a re
case in which there were five kidneys, each with a separ
ceiving viscus, no operative measure is indicated. Sacculatio
attendant cystitis from defect of drainage, would indicate sim
treatment of the cystitis. Enormous dilatation of the ureter, if
be diagnosed, would indicate the relief of the stricture or the
tion of a new opening between the dilated ureter and the blad

Complete Absence of the Bladder.—When the bla
completely absent, the ureters open into the urethra, the vagi
rectum, or the umbilicus. The condition may be treated by
plication of a urinal, which prevents the garments from being
or by implantation of the ureters into the bowels.

Exstrophy, or absence of a portion of the bladder-wall, i
means uncommon. The anterior wall is the portion usually
though cases are reported in which the septum separating th
der from the vagina or the rectum has been absent. Exstro
extroversion is observed most frequently in male children, and
to the failure of the lateral portions of the uro-genital cleft to
Hence in pronounced cases there is a deficiency not only in th
rior wall of the bladder but also in the musculo-cutaneous abd
parietes and the pelvic girdle, the pubes not meeting in the
line to form the symphysis. This deformity is associated wi
spadia in the male and split clitoris in the female, the bladd
urethra opening in the female either into the vagina or just ab

From weakness of the abdominal parietes there is commonl
ciated with this deformity complete double inguinal hernia,
descending into the cleft scrotum, causes its two halves clo
resemble the labia majora of the female. The prostate is ru

s often are ectopic. The recti muscles pass upward either side from their insertion into the separated es this separation is continued upward almost to the cles, allowing the formation of ventral hernia.

g a case of exstrophy of the bladder there is found hypogastric and pubic region a bulging, moist, dark intensely inflamed rugous mucous membrane, surarea of cicatricial tissue, uniting its borders to the ection varies in size from that of a half walnut in in- man's fist in adults. It bleeds readily, is extremely er portion is wet, and the projections marking the can usually be found by the escape of urine, which in jets. This tumefaction may extend upward as cus.

vith the lower border of the mucous surface is the as a furrow on the dorsal aspect of the rudimentary e of which forms a large flap hanging from the under ans. The pubes may be separated for a distance of es. The seminal vesicles are either absent or are l. The ureters are often dilated, and sometimes so at consequent obstruction and dilatation occur. In greater and lesser vulvar lips are not joined anteclitoris is split, the vagina being converted into a Patients exhibiting this deformity are usually of poor ment in other respects, and often perish from ascendis. As a result of the leakage of urine inseparable the surrounding skin becomes infiltrated and excopelas sometimes develops. Sexual desire is generugh in the female this deformity does not necessarily rturition.

eformities are by no means uncommon. At times the anus opens through the exstrophied mucous memly the anus is placed farther forward than normal. club-foot may be associated with exstrophy.

strophy varies from the slight form characterized by cicatricial condition of the skin in the neighborhood the form in which there is separation of the pubic , to the form characterized by complete hypogastric tration. Between these extreme degrees of exstrophy adation. Heredity exerts no influence in causing this

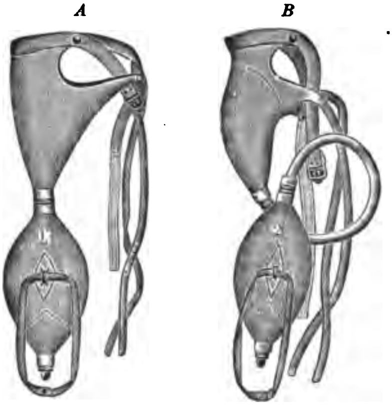
s of exstrophy is unmistakable. The scar-tissue surrounding the mucous membrane is congenital, and is not due vious destructive inflammation.

The *prognosis* must be guarded, since the conditions are fa to kidney-infection.

Treatment may be either palliative or radical. Palliative tre consists in the application of a urinal so constructed that a rubber cup accurately fits the skin surface surrounding the cle thus enables the urine to be drained off into a reservoir. (Fig

Radical operation consists in closing the defect by plastic tions, or in diverting the ureters.

FIG. 132.



A, day urinal; 1, detachable reservoir. *B*, night and day urinal; 2, detachable reservoir.

The most successful radical operation can never make factorily retentive bladder, since a sphincter which will be proper nervous control can formed. Plastic operation ally aim to lessen deformi to close the bladder sufficie allow of easy drainage by me a urinal, thus protecting th rounding skin from irritati enabling the patient to keep h clean. Wood's operation is t most in favor. A cutaneou the attachment of which sponds to the upper border cleft, is turned down from ab bladder. This flap should be ficient length to cover entir exposed mucous membrane skin surface thus forms a ne terior wall for the bladder. The lateral borders of this fl sutured with catgut to the freshened skin borders of the con cleft. There is thus formed a pouch, the anterior wall of sk posterior of mucous membrane. The raw outer surface of th flap is then covered in by two lateral rectangular flaps which their attached bases placed in the inguinal region of each side. two flaps are made of such length that without undue tensio can be carried transversely across the raw surface of the firs covering it completely. The free borders of these flaps are together with silkworm-gut. Finally, the large wound resultin the transplantation of these flaps is closed in as far as poss means of silk sutures.

Closure of the bladder by direct suture possesses the adv

;ical cavity consisting entirely of mucous membrane.
is narrow this operation is not difficult: the borders
ied bladder are denuded and are approximated by
tures. When there is bone-defect, an essential point
erforming this operation is the approximation of the
. This may be accomplished in infants by gradual
d by means of an elastic belt or a spring truss.
ıdvises subcutaneous symphyseotomy of the sacro-
wed by forcible lateral pressure and the application
aratus. He used a leather girdle crossing in front
weights on each side. After the pubic bones have
;ether the bladder-cleft can be readily closed by direct

defect represented by the projecting mucous mem-
terior bladder-wall is too wide to allow of closure by
Jnder these circumstances, and since symphyseotomy
le, because of the difficulty of keeping the wound
be made an extra-peritoneal dissection of the bladder
ıp thus obtained is brought down to the penile furrow,
edges of which it is sutured. This having been done,
ɔlit, is perforated at its base and carried up over the
de to cover by its raw surface the vesical flap where
hral roof. Finally, flaps are dissected, as in the last
operation, and are made to cover in the raw surface
ıe dissection of the bladder. There results, accord-
canal the walls of which are formed by the penile
turned-down bladder, and are hence exclusively
liable to favor the development of calculi.

sts that instead of practising the extra-peritoneal dis-
ladder-wall the whole thickness of the latter should
ts parietal attachment by a cut carried around its
ening the peritoneal cavity. Thus there is formed a
des the muscular and peritoneal investment of the
ot likely to slough. The abdominal defect is closed

own that this method is perfectly practicable.

on of the ureters has been so frequently followed by
ephritis and death that this sequel has been regarded
om the operation. There is, however, reason to be-
avoidable, and that it is due in great part to narrow-
lanted ureteral orifice and backward pressure on the

Maydl has successfully accomplished this transplantation l ing the peritoneal cavity at the border of the exstrophied blac removing the whole of the latter except a small segment cc the ureteral orifices. Into the ureters are passed small cathete small bladder-segment left, together with the attached ureters, oughly mobilized; the colon is drawn out and incised longit and in this opening is secured the portion of the bladder-w taining the ureters. The mucous membrane is first sewed mucous membrane of the gut, then the musculo-peritoneal of the intestine is sutured to the muscular wall of the bladder-s Finally the abdominal wound is closed by suture.

Orloff collected fifty-six cases of Maydl's operation. Elev died within twenty-one days after operation; four from pe Of the forty-five remaining cases only five died of the later r ascending infection. The post-operative complications have bee monia in six cases, fæcal fistula in seven cases, phlebitis of t one. Some renal colic and albuminuria were noted in ne There is little irritation of the bowel and the anal sphincter competent.

Peters (*Canadian Journal of Medicine and Surgery*, Apr describes in detail an excellent method of implanting the ure the rectum by the extra-peritoneal route.

A consideration of the various operative methods appli exstrophy leads us to believe that in certain appropriate c method of choice is direct suture of the freshened bladder- thus forming an irregular cylinder, which acts not as a reser as a conductor of urine, allowing a portable urinal to be en In children an effort should be made to close the bony d elastic or weight pressure. Symphyseotomy is by no me from danger. The exact value of this procedure and the a risk inseparable from it remain yet to be determined. Wl cessful, it enables the surgeon to close the bladder and a the urethra by direct suture.

When flaps are required to close the defect, these shoul possible, be of mucous membrane made at the expense of strophied bladder. It would seem advisable to use the whol ness of the bladder-wall. This requires opening of the p cavity, and, since the tissues operated on are infected, ma peritonitis. Careful preliminary cleansing of the parts and th use of intraperitoneal pads should prevent this danger.

Wood's operation, while objectionable because skin surf turned in, is on the whole the one which with the least risk c ıtages. The result is not so satisfactory as that folure, but the percentage of cases to which the latter ble is far less, and the proportion of operative suc- operation is greater.

ation is theoretically the most satisfactory immediate rophy.

eration is performed the inflamed skin surrounding be rendered healthy by cleansing washes and healves. Thus, twice daily the parts may be bathed in hyol solution, followed by the application of a thick by adding four drachms of finely powdered zinc of benzoated zinc ointment. This paste is removed osmoline.

plastic operations the newly formed bladder-cavity out gently with boric acid solution or other dilute wo hours; a fountain syringe and a soft catheter is purpose. The dressing of sterile gauze applied ne of suture is changed at the same time, the operaed with corrosive chloride lotion, and a clean dresshe surrounding skin surfaces are protected from exaking urine by thick zinc oxide ointment. Urinary l be given by the mouth, to lessen the danger of n. Should symphyseotomy have been performed, l be closed without drainage, and should be dressed llodion.

tment of hypospadia and epispadia, repeated efforts efore a satisfactory result is achieved.

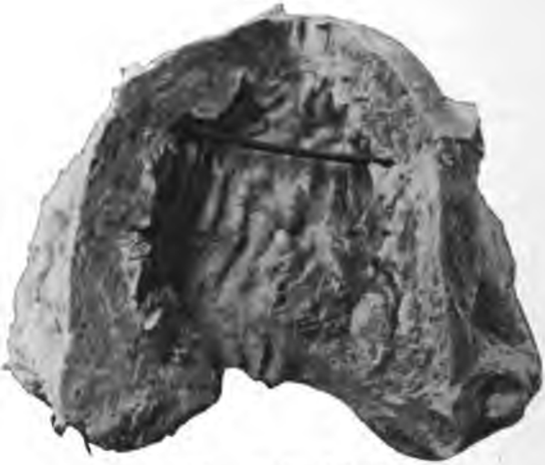
hus.—Occasionally, as a congenital defect, the comen the bladder and the allantois is not entirely oblit- birth urine escapes through the umbilicus. This lly due to the back pressure incident to urethral

nsists in first rendering the urethra patulous. This ufficient to produce a cure. If the fistula still per- dressing, the application of the actual cautery, or nus is indicated. Urinary concretions and suppuy form.

y of the Bladder.—This term implies an overesical muscles. Sometimes it is associated with g of the mucosa. It is always caused by increased incident to mechanical obstruction to the escape of dder or to abnormally frequent micturition.

In cases of obstruction, particularly if it is at the vesica
there is usually coincident with hypertrophy a dilatation,
partial sacculation, of the bladder, the weaker portions of th
between the thickened muscular fasciculi yielding. In vigorous
men, and this particularly represents the type suffering from
stricture, muscular hypertrophy may be universal, the result

FIG. 133.



Concentric hypertrophy of the bladder.

creased expulsive force of the bladder preventing retention a
ondary dilatation. In older men, with enlarged prostates, th
cally dilated, thickened, trabeculated, and possibly sacculated
develops. Hypertrophy dependent upon frequent urination
obstruction, as in some cases of chronic posterior urethritis, is
concentric and lessens the size of the vesical cavity. Cystitis
ally associated with hypertrophy, adding to the thickness of th
der-walls. (Fig. 133.)

The ultimate prognosis of hypertrophy is bad, since fib
fatty degeneration is liable to occur, with consequent diminu
entire loss of contractile power.

Diagnosis.—This, when the hypertrophy is associated with
ulation and dilatation, is made either by the cystoscope or by ex
tion with a vesical sound. Even when the bladder is well dis
the point of the explorer can be felt scraping and jolting o
ridges made by the hypertrophied muscular fasciculi. Whe
is concentric hypertrophy without dilatation, the lessened
of the bladder and the detection of its greatly thickened walls

and suprapubic palpation, together with a preceding
r frequent or difficult micturition, point to the true
ffection.

-The direct treatment of the hypertrophy is unavailing.
uction or of the necessity for frequent micturition will
if this is accomplished before degenerative changes

f the bladder may be caused by distention or by
nsequent on nerve-lesion. In old age there has been
degeneration of both the detrusor and sphincter mus-
sult of muscular atrophy the bladder loses the power
s contents and becomes a thin, sometimes enormously
If the sphincters, including the compressor urethræ
ophied, there will result incontinence of urine; this
ally associated with retention.

he Bladder.—Weakness of the bladder muscularis,
gical in people past middle life, is usually due to over-
h may be acute and temporary as from lack of privacy
desired act of micturition, sudden urethral obstruction,
ic retention, or may be chronic and persistent as from
oped urethral obstruction or habitual deferring of the
on. The hypertrophied bladder inevitably becomes
the viscus which is subject to prolonged drainage.
dder may form a thin, enormous pouch, containing
luid (Fig. 134), or, if associated with hypertrophy, may
ty even less than normal.

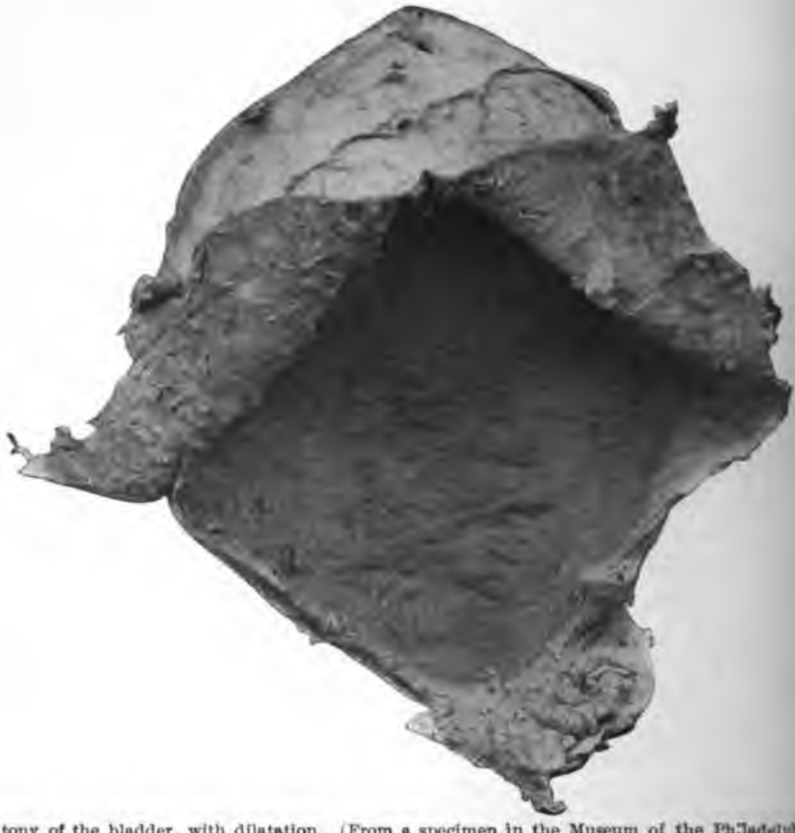
-This is based on the history of an adequate cause,
the aged and in those subject to exhausting fevers
primary. The stream of urine lacks in propulsive
n a catheter is passed, unless the abdominal muscles
o play. There is always some residuum after urina-
uency of urination is usually noted.

-After removal of the cause and the cure of the com-
nying cystitis, the atonic condition of the vesical mus-
efited by strychnine, irrigations with hot normal salt
e use of the slowly interrupted faradic current, one
introduced into the bladder, which should contain not
ounces of fluid.

he Bladder.—Under this term is included protrusion
bladder-wall along the track usually taken by intes-
guinal cystocele is the common form, though there are
urator, crural, and perineal vesical hernia.

Inguinal cystocele may appear in the form of a projection of the bladder without a true hernial sac,—that is, without a peritoneal covering,—the muscular coat of this viscus lying in immediate contact with the transversalis fascia and adhering to it. This is the usual form, and rarely attains large dimensions. Exceptionally there is partial or complete sacculation at the expense of the peritoneal investment of the bladder. Still more rarely the herniated bladder forms a tumor entirely covered by its own peritoneum and invested in an additional true peritoneal sac. Either the summit or the lateral surface of the bladder is the portion found prolapsed. Even the most pronounced displacement is not sufficiently extensive to displace the ureters.

FIG. 134.



Atony of the bladder, with dilatation. (From a specimen in the Museum of the Philadelphia Hospital.)

The herniated portion of the bladder usually presents thin walls, is often surrounded with considerable fat, and sometimes appears as vith an extremely small opening into the general e capacity of the latter not being particularly dimin- ıgnation of the urine in these diverticula calculi may

f hernia of the bladder are overdistention and dila- gan and a patulous condition of the hernial orifices. er is the first viscus to appear in the hernial region, ace, uncovered by peritoneum, descends, possibly a preceding lipomatous formation. After this fol- vered by peritoneum, forming an artificial sac, into ay subsequently descend. The most frequent cause a is a preceding intestinal hernia, which, as it pro- s on the peritoneum in the formation of a sac, in- er.

The characteristic symptom of hernia of the bladder f a fluctuating tumor, dull on percussion and varying dance with the amount of urine contained in the umor may not grow smaller, even though the bladder nptied, since it may communicate by a small orifice, when the patient is in the erect position. On lying and particularly after manipulation and gentle auses a desire to urinate, the somewhat tense fluctu- omes small and flaccid, and immediately a quantity gain evacuated. The flaccid, inconspicuous swelling nd full when injections are forced into the bladder. are absolutely diagnostic. In addition there are of bladder irritation, such as frequent and difficult ion, or evident cystitis. Exceptionally, when the n of the bladder is small, it offers no symptoms associated with an irreducible omental hernia.

ı is commonly complicated by enterocele or epiplo- is displacement is not suspected till, in the course of stinal hernia, escape of urine shows that the bladder

this affection should be operative. A truss is not reduction is impossible. The operation consists in ng the bladder free of its adhesions, reducing it to its nd permanently closing the hernial opening.

ONTUSION, AND RUPTURE OF THE BLADDER.

when empty is so deeply placed, so well protected the pelvis, and, moreover, so movable, at least in its upper part, that it usually escapes the effects of even severe tism. When force has been applied sufficient to fracture t bones or to cause disjunction at the pubic symphysis, even th bladder may be bruised, punctured, or lacerated. Horns, or pointed stakes may wound this viscus when driven into neum or rectum, through the obturator or sciatic foramen, the pubis. Bullets may reach the bladder either through th of the pelvis or directly through its bony substance. Rougl mentation may cause laceration of the vesical walls. Final the bladder is full or overdistended, force applied from with though insufficient to cause disjuncture of the pelvic bones ficial bruising, may occasion either contusion or ruptur bladder.

Wounds of the Bladder.—The term wound implies a of the continuity of the soft parts extending from the skin down to the bladder-lesion. Rupture and contusions will rately considered. Nearly all wounds of the bladder can be c contused or lacerated, including under these headings gunshot

Incised wounds are usually inflicted by the surgeon, eith tionally, as in cystotomy, or accidentally, as in extirpation tumors. In the latter case prompt closure of the wound by nearly always followed by immediate union, the danger in this accident lying in the risk that it may be overlooked. wound does not entirely penetrate the visceral wall, involvin stance, the serous and muscular coats only, the mucous coat r intact prevents extravasation, and cicatrization is unhindered.

Contused and lacerated wounds, the common variety, ar inflicted by way of the perineum or the rectum, as the result upon a stake or a paling, or are due to wounding by firearm are also caused by inadvertence in surgical manipulations Neumann in extracting a stone adherent to the vesical wall aged nine, tore an opening through both bladder and rec accordance with the portion of the bladder involved the termed intraperitoneal or extraperitoneal. From the stand- prognosis this classification is highly important.

Symptoms.—The symptoms of wound of the bladder are— of urine through the wound; 2, frequent straining efforts at u with the passage of blood or bloody urine; 3, the detecti opening in the bladder by means of a probe passed thr wound, or of a sound passed through the urethra, aided b examination per rectum, or by a combination of these met shock.

nptoms may be absent except blood in the urine. through the wound can take place only when the is of some size and is fairly direct. In the case of a ch as would be made by a twenty-two-calibre pistol-emains direct only so long as the bladder maintains of distention as at the moment of wounding. In he traumatism the urine almost immediately escapes, ler contracts the opening through its walls no longer line as the wound of the parietes. Moreover, con-uscular layers makes the opening through their sub-nd the mucous membrane has a tendency to pro-occlude the wound more or less completely. It is vound is large and direct that this pathognomonic upture will be found.

smus and the frequent voiding of a small quantity dy urine are noted as a rule, these symptoms are not d. There may be absolute inability to pass anything by the urethra. Introduction of a probe into the the wound is most difficult where this viscus has ation of its wounded wall to the parietes, though uvre is successful, and when the probe can be made catheter carried through the urethra into the bladder, of course, certain.

OF WOUNDS OF THE BLADDER.—Immediately following bladder hemorrhage may prove a serious complica-so violent as to threaten immediate death, nearly om the large vascular trunks in the pelvis, and not wall.

rs or days usually, but sometimes in cases of gun-until after one or two weeks, septic peritonitis may raperitoneal wounds, or septic cellulitis from extra-s.

omplications are fistulæ, which may pass from the gina, to the rectum, or to the external skin surface, which may be formed around foreign bodies, such as ments of the garments, or splinters of bone.

When the typical symptoms are present the diagnosis When these symptoms are mainly wanting and the dy urine and a wound of entrance passing in the bladder are the only signs suggestive of the lesion, e vesical walls by means of a sound passed through d by digital exploration through the rectum, is indi-

cated. If this is not conclusive in its results, the injection a
diate withdrawal of a measured quantity of dilute antiseptic
may prove serviceable. (See Rupture of the Bladder.) If
not clear the diagnosis, the cystoscope should be used, the
being first washed clear of blood by irrigation with a hot
solution. If there is too much blood in the bladder to allo
use of the cystoscope, suprapubic or perineal cystotomy s
performed for the purpose of establishing the diagnosis, th
of operation depending on the position of the external woun

Prognosis.—This depends upon whether the wound is e
toneal or intraperitoneal. The intraperitoneal wounds are
fatal from septic peritonitis, though recovery from extravasat
becoming encysted and absorbed, or from closure of the
wound by adherence of bowel or omentum to its peritoneal
possible.

The prognosis of extraperitoneal wounds is much mor
ble; in the absence of lesions of other organs the large maj
recover. Large, clean, direct wounds, and wounds inflicted
nerating bodies entering through the rectum or the vagina
drain well. The outlook for gunshot wounds is favorable in
tion to the freedom with which urine escapes to the surface
wounds of both entrance and exit are less serious than woun
trance alone. When from lack of thorough drainage extrap
urinary extravasation and cellulitis occur, the symptoms bec
nounced at about the end of the first week.

Treatment.—Since extravasation of urine and subseque
inflammation are the main dangers incident to wound of the
the most important indication in the treatment of these wou
to provide for drainage of the bladder that there can be no
lation of urine, and hence no condition favoring escape of
into the peritoneal cavity or the cellular tissues.

When the wound is intraperitoneal, it is safe to assume t
and urine have already entered the peritoneal cavity. Henc
diate laparotomy is advisable, followed by careful toilet of th
neum, closure of the bladder-opening by suture, closure of the
and either suprapubic or perineal drainage or permanent cat
tion. In case the catheter is repeatedly blocked by clots,
by incision should be resorted to at once. The urine s
rendered antiseptic by the administration of salol and boric
all manipulations must be conducted with the utmost cleanlin
the wounded bladder is strongly predisposed to cystitis. W
wound is extraperitoneal, suprapubic or perineal drainage is

th the position and direction of the wound. Suture
in these cases rarely practicable.
is treated in accordance with general indications,—
oderate, injections of hot astringent antiseptics (four
n of antipyrin) may be employed, together with the
ration of ergotin. When it is severe and persistent,
cking, the application of forceps, or incision, exposure
oints, and ligation.
quires immediate laparotomy, cleansing, and thorough

tis is treated by free incisions carried deep into the
chio-rectal fossa, over the pubis into the space of
ever else there is a uro-purulent infiltration.
of the Bladder.—Contusion of a healthy bladder
of its walls, though proved to be possible by a few
s probably a rare form of injury. Theoretically it
l by the causes which occasion rupture of this viscus,
rce applied to the anterior abdominal wall when the
istended. It is easy to imagine that if this force is
nay cause rupture of some of the blood-vessels lying
e mucous membrane, and thus may cause bleeding

ns of this injury are commonly partial or complete
us, pain, tenderness, and the passage of blood-stained
s. Shock should be moderate or altogether wanting.
rticularly in a bladder which has been the seat of
ding may be persistent and severe.
s is of importance, since this injury must be distin-
ture. Examination with the cystoscope after bleed-
may aid in excluding rupture. Most reliance can
jection of the bladder with a measured quantity of
on. If such a solution is forced in under moderate
ined for two or three minutes, and on being with-
eter is found to have lost nothing in volume, it is fair
there is no breach in the continuity of the vesical

The treatment of contusion depends entirely on the
symptoms. When bleeding is slight and there is
ation, rest, the mouth administration of urinary anti-
control of tenesmus and pain by hot baths, hot
resses, and opium and belladonna suppositories will
eutic indications. Even when there is some obstruc-

tion by blood-clots to the free passage of urine, it is well t from interference, provided dirty instruments have not bee into the bladder previously and the urine is sterile. Should become well marked, a sterile full-sized catheter should b immediately, under the antiseptic cautions described when tr retention, and the clots sucked out by a syringe, or, if this means of the large evacuating catheter and aspirator of a lith instrument. If there is persistent bleeding, continuous cat tion is indicated. Should the hemorrhage be profuse, su cystotomy should be performed; the bleeding points can subjected to direct treatment. If there is cystitis, clots sh evacuated, even though there is no retention, and the bladde be irrigated twice daily with a mild antiseptic solution (silve 1 to 1000, boric acid four per cent., or Thiersch's solution).

Rupture of the Bladder.—This injury may be eith peritoneal or extraperitoneal. It may be traumatic or path So-called idiopathic cases are always secondary to some ob or degenerative factor. It usually occurs at about the prime

The causes of rupture of the bladder are predisposing and

Of the predisposing causes the one of greatest importance is dition of distention. Indeed, it is difficult to imagine how th viscus can be ruptured unless there are extensive concomitant

Alcoholism is a predisposing factor, but mainly because it encourage a condition of over-distention of the bladder, from that it simulates the kidneys, and so obtunds sensibility that th to micturate is not noticed, even when the bladder is full.

Fixation of the bladder by pelvic cellulitis, degeneratio walls from chronic cystitis or atheroma, and disturbed inn may also be counted as predisposing factors.

The exciting causes are fracture of the pelvis, separatio pubic symphysis, violence applied either directly or indire muscular strain. Thus, kicks in the stomach, falls upon the and the straining incident to parturition, defecation, urinatio ing, have caused this injury.

Vesical tension from acute retention of urine, or from i practised for the cure of cystitis or in the preparation for sto ations, may cause rupture of the bladder without the interve strains or traumatism.

Thus, Dittel performed suprapubic cystotomy for the rem stone in a child aged three. The bladder was injected with than three ounces, and the colpeurynter contained not ounces. The patient perished the next day in collapse, wit

stitis. In the posterior wall of the bladder there was
wo-fifths of an inch in length, running into a diver-
caused infiltration of the pericystic cellular tissue.
l rupture—that in which the bladder-walls give way
ntion, without the intervention of force—is usually due
prostate, since, in the case of stricture, the urethra
es posterior to the seat of narrowing, and tension is re-
vasation of urine into the periurethral cellular tissues.
that the majority of cases of rupture attributable to
ı will exhibit pathological changes incident to urethral
e great thickening of the bladder-walls occasioned by
n proving no safeguard against this accident. Cystitis
s usually complicated either by ulceration or by saccu-
ving a weak portion, which may rupture from slight

f rupture may be either intraperitoneal or extraperi-
ck states that it is intraperitoneal in eighty-eight per
Ulmann estimates the proportion at eighty-five per
ater frequency of intraperitoneal rupture is partly due
t the area covered by the peritoneum is larger and is
by the pressure of closely attached surrounding tissues.
eritoneum is less elastic and distensible than the other
tting suddenly, tears the muscular and mucous coats
force applied to the hypogastric region usually causes
ıpper and posterior bladder-wall. Ruptures due to
pelvis and spontaneous ruptures are apt to be extra-
e rupture is commonly single, is vertical or oblique
d when intraperitoneal the peritoneal aspect is most
ı.

-The symptoms of rupture of the bladder are a sense
ving way within the abdomen, hypogastric pain, often
ant desire to urinate, passage of a few drops of blood,
ined urine, or failure to pass anything, and severe

hese symptoms, under appropriate treatment reaction
ace, and there is a period, varying from hours to days,
e patient suffers from pain and tenderness in the hypo-
tenesmus, and a constant desire to micturate, and
no urine.

of the hypogastric region demonstrates percussion dul-
se of resistance closely simulating that of a distended
rectal examination may show effusion into Douglas's

cul-de-sac or the cellular tissues lying at the base of the b There then follows, in accordance with the location of the r either septic peritonitis, usually terminating fatally in five days, lulitis, which progresses more slowly, and is attended with the toms of septicæmia, sometimes running a course of several we

Diagnosis.—The diagnosis of rupture of the bladder is fo upon the history of the case, the symptoms already detailed, shock, tenesmus, urgent desire to micturate, which the patient satisfy, or frequent urination and the passage of blood, and up results of direct examination. All the subjective symptoms excited by contusion of the abdomen; if there is also contusion bladder the urine will contain blood. The bladder may be ru without exciting a single characteristic symptom. Coates repo cases of rupture of the posterior wall in which the lesion was n pected during life, no signs of acute peritonitis having developed peritoneal cavity was flooded with sterile urine; death was att to absorption of the urine by the peritoneum, with a consequen effect upon the blood. In two of thirty-five cases collected by the urine contained no blood. In both cases the rupture occu the vertex, the least vascular part of the bladder.

The simplest method of exploration consists in the passa thoroughly sterilized silver catheter. If this draws off blood and clots, the probability of rupture is strong. If on manipula the shaft so that the tip is made to traverse the inner surface bladder this tip repeatedly catches at one point, and apparen be passed through the bladder-wall, so that it can be felt imme below the skin or mucous membrane surface by palpation hypogastric region or through the rectum, there can no lon doubt about the existence of a rupture.

When this means of exploration fails, the cystoscope is av but only after active bleeding has ceased.

The injection of an antiseptic solution is by no means an in test, since even an extensive rupture may so quickly close by matory adhesion that a solution injected with gentle pressure break this down, and the total quantity injected is at once re

Weir states that this injection method (Cabot's) is made reliable by several repetitions, enough fluid being driven in ea markedly to distend the bladder. The method is rendered stil serviceable by preceding the injection by a careful digital exam of the rectum, followed by the insertion and distention of the bag. The bladder is then injected with a known volume of flu there results rapid increase in pelvic tumor and dulness, as d

xamination, this must be due either to the distended
ravasated fluid. In the latter event failure to recover
n all the fluid injected will show the presence of an
rupture. In case there is developed no suprapubic
the fluid is not recovered, there must be either an
r a subperitoneal postero-inferior rupture. In the
rawal of the Barnes bag and a second digital exam-
ctum will show the increase of extravasation. The
s not more reliable as a means of diagnosis than is

loubt there should be no hesitation in performing
c or a perineal cystotomy and thoroughly exploring
e finger and by sight. Always, when instruments are
stic purposes, the principles of surgical cleanliness
y observed, and if a rupture is found, operation should
once.

Rupture of the bladder results fatally in a large pro-
and the prognosis is particularly grave when the rent
y fracture of the pelvis and when it is intraperitoneal,
n the great majority of these cases in the first five days.
covery, though possible, is so rare as to constitute a
. The extraperitoneal tears are somewhat less fatal,
nce of proper surgical intervention the majority of
The prognosis is undoubtedly better to-day, when
nerally employed in the treatment of bladder-lesions,
er septic period. The urine when first extravasated
ladder is a sterile fluid and does not cause inflamma-
not infected by the use of dirty instruments, it under-
wly.

ns for germ-growth are, however, so favorable that
ection is followed by rapid and extensive suppuration.
rated on within the first twelve hours, the mortality
eight per cent., from twelve to twenty-four hours
, after this about seventy-three per cent.

thirty-five cases, twenty-one of which were operated
en of these recovered.

ed fifty-four cases of intraperitoneal rupture of the
by suture, with a mortality of forty-eight per cent.
livided into two groups, previous to and since 1893.
ere thirty-two cases with a mortality of sixty-three
cent., while since 1893 twenty-two cases have given
nly twenty-seven and one-half per cent.

Causes of death are most frequently peritonitis (seven twenty-six cases), shock, and hemorrhage.

Schlanger notes ten recoveries out of twenty-two operat intraperitoneal rupture. Seven out of ten were cured wl rupture was extraperitoneal.

Treatment.—If the wound is intraperitoneal, an immedia rotomy, thorough cleansing of the peritoneal cavity, and clo the bladder by suture are indicated. It is important that thi tion should be performed immediately,—that is, before the b of peritonitis. When exploration fails to show whether the intraperitoneal or extraperitoneal, suprapubic cystotomy sh performed and a diagnosis thus made; if further room is r the lateral incisions of Trendelenburg, or even symphyseoto be necessary.

The suture by which intraperitoneal bladder-wounds are applied exactly as is the Czerny-Lembert suture in deali wounds of the gut: that is, the stitches are placed about si inch; the first row, preferably of fine sterile catgut, closes t each stitch including all but the mucous coat of the bladd line of union is then turned in by a second row of Lembert the needle is passed in and out on one side of the wound ve its length, and, including the serous and muscular coats, it cro wound and is passed in and out as before on the opposite s these sutures are knotted the peritoneal surfaces are brought i sition, and inflammatory agglutination takes place in less than four hours. When the sutures have been properly applied in non-infected tissue there is no tendency to the reopening wound. To make sure that the wound has been thoroughly the bladder should be moderately distended with mild antisep tion; if apposition is perfect there will be no leakage. The neum should be thoroughly cleaned of clots and of extravasate This is best accomplished by dry sponging. When septic pe has already been excited, hot irrigation with normal saline so indicated, followed by drainage-tubes, or the antiseptic tam accordance with Mickulicz's method. In large, irregular, cont lacerated wounds of a diseased bladder the line of suture ca trusted. The wound should be rapidly closed by a continuou suture, and gauze drainage running down to the region o should be continued for several days.

When suprapubic cystotomy has been performed for exp purposes and the rent is found to be extraperitoneal, it sh thoroughly cleansed and closed by interrupted suture. The sure of the wound is concerned, are not so satisfactory ed by the suture of intraperitoneal openings. Hence or a gauze tampon should lead to the seat of injury, for the free escape of urine in case the sutures should

eatment of operation for bladder rupture consists in t of continuous catheterization for from three to eight h the patient is allowed to urinate. The method of s catheterization is the same as that described under f retention from prostatic enlargement. Extraperito- are treated by permanent catheterization, supple- iseptic irrigation of the bladder practised night and e surgeon distrusts the permanent catheter, as he nost cases with extensive and complicated wounds, ion drainage or the insertion of a tube through the icated.

ılarly that referred to the rectum and running down rigors and fever, point to extravasation and cellulitis, ner a suprapubic or a perineal cystotomy. The supra- is preferable unless œdema, tenderness, and swelling erineum is the seat of infiltration.

CHAPTER XI.

CYSTITIS.—VESICAL TUBERCULOSIS.—VESICAL SYPHILIS.—VESICAL

Cystitis is an inflammation of the bladder due to germ-inf The sudden acute congestion due to retention, chilling, i conditions of the urine, or foreign body, is not considered a inflammation, since, unless there is added to this congestio infection, the condition is transitory, and is attended by no barring vascular engorgement. Yet while the congestion l symptoms, with the exception of pus and micro-organisms urine, are identical with those of acute cystitis.

Classification.—Cystitis, in accordance with its clinical cou be acute or chronic. From the pathological stand-point the may be—

1. Superficial or catarrhal.
2. Interstitial.
3. Pericystic.

Further subdivisions, sufficiently indicated by their nar pseudomembranous cystitis and gangrenous cystitis.

Etiology.—The causes of cystitis are predisposing and The predisposing causes are those which favor congestion an tion, the latter condition implying the former, since an bladder is always congested. A normal bladder containing urine which is evacuated at proper intervals is not readily Even though germs be carried directly into its cavity, by dirty ments for instance, the resistance of the healthy tissues is to prevent penetration and multiplication of micro-organisms.

The causes of vesical congestion are—1. Retention of urin vesical congestion is in proportion to the acuteness of the re hence a sudden distention of the bladder is a more favoring the development of cystitis than is a gradual accumulation 2. Trauma. This may be due to jar, strain, contusion or la rough instrumentation, or bruising by a stone or other foreig 3. Muscular contractions abnormally frequent or prolonged. may be excited reflexly by lesions, irritations, or inflammation rectum, sexual organs, kidneys, or urethra, or may be due to h sitiveness of the micturition centre, to habit, to polyuria, or

Abnormal conditions of the urine. If the urine is
ged in any of its characteristics, it will eventually act
the vesical mucosa. If it is strongly acid, markedly
ery low or very high specific gravity, it occasions con-
the gouty and rheumatic, dyspeptics suffering from
haturia, or other urinary changes, diabetics, cachectics
, persons who have been severely burned, and those
ed overdoses of drugs such as cantharides, turpentine,
ohol, or arsenic, are predisposed to cystitis by vesical
Tumors and calculi. It should be borne in mind that
culi do not in themselves cause cystitis, but merely
s development by the congestion which their presence
y the admixture of blood with the urine, thus rendering
peculiarly rich as a culture fluid. 6. Surface chilling,
the feet wet or sitting on the damp ground, may cause
ery marked congestion of the bladder, though never
7. Prolonged sexual excitement or excess in sexual
potent factor in the production of bladder hyperæmia.
kness, venous obstruction, and atheromatous degener-
essels are factors often operative in the aged, which
l, as is often the case, with an enlarged and inflamed
ence with retention of urine, make the development of
ertain. 9. Lesions of the central nervous system by
-motor control and favoring retention of urine strongly
pment of cystitis.

of the bladder is, then, the condition which most pre-
itis. When to the congestion is added retention, par-
alkaline and albumen- or blood-containing urine, the
conditions for germ-infection are present. It is clear
he causes of acute congestion may be operative at the
is, during acute fever there may be atonic retention
is irritating from the pyrexia; or after spinal injury
vaso-motor dilatation, combined with retention from
.

cause of cystitis is local infection. This infection is
to catheterization and urethritis. Infection by way of
also take place, but probably not unless the kidneys
ough it has been demonstrated that apparently healthy
iminate pyogenic organisms.

uppuration may also occasion local bladder-infection
he bladder-wall and discharging pus into its cavity.
proved that infection is not always due to catheteriza-

tion or to extension of inflammation from the urethra. The r
may enter the bladder from the kidneys, by the agency of th
or lymph-channels, or they may pass directly from the rect
direct passage being particularly liable to take place in cases
stipation, inflammation, hemorrhoids, tumors of the rectum, o
of the prostate.

Normal urine is sterile. In the urine of cystitis have bee
a great number of organisms, many of them without pyogeni
Of the micro-organisms which occasion cystitis the colon ba
the one most frequently found. After this come the staph
and streptococci of ordinary pus and the bacillus proteus
It seems clear that the gonococcus may invade a part or
whole of the trigonum, but there is evidence that the remainin
mucous membrane is at least partially immune to its attack.
true bladder-inflammation traceable to gonorrhœa are usuall
mixed infection. This is also true of post-typhoid cystitis,
cases are reported in which the urine contained pure typhoid

The tubercle bacilli will be discussed under the head of T
losis of the Bladder. In themselves they are not able to cause
cystitis, but they strongly predispose to mixed infection.

Germs exert their injurious action upon the bladder-tissu
directly or through their ptomaines. The inflammation they
is increased by the ammoniacal fermentation of the urine wh
bring about. This fermentation is due to the decomposing a
microbes upon urea, ammonium carbonate being formed. T
verts the pus into a ropy, gelatinous mass, renders the urine m
alkaline, and makes it thick, foul, and ammoniacal. Practi
the pyogenic germs and many others found in the urine
titis produce this ammoniacal fermentation. As a result the u
comes intensely irritating: hence the cystitis is aggravated.
however, be borne in mind that this fermentation is the r
cystitis, and not its cause.

A condition essential to the formation of ammoniacal uri
tention, which must at least be partial. Even when retention is
this fermentation takes place to a minor degree or not at all w
urine is acid and contains but little urea and when the pus-fo
is slight. Retention of an abundant purulent secretion and s
of urine rich in urea are most favorable for this fermentation
absolutely diagnostic of cystitis, though care must be taken to
the urine has undergone this fermentation at the time of passin
under certain conditions it may take place very shortly afterw

Cystitis has for its seats of predilection the trigonum, the

region about the ureteral openings. It is in these
arly that the most pronounced lesions are usually
ugh the entire vesical mucous membrane is involved.
R CATARRHAL CYSTITIS in its acute form is characterized
edematous, ecchymotic mucous membrane the vessels
arkedly engorged. Erosions or distinct ulcerations
Exceptionally shreds of necrotic mucous membrane
ne urine is usually acid, and contains pus and much
um.

ficial cystitis becomes chronic, reddening of the thick-
embrane is no longer pronounced. Indeed, this may
ish hue with prominent veins and areas of exfoliation
ite by thin layers of pus or urinary salts. From the
l congested mucous membrane small polyps may
ner surface of the bladder is often trabeculated from
rophy.

generally alkaline; when markedly so from ammo-
ion, there is often found overlying the mucous mem-
itish deposit of muco-pus.

CYSTITIS exhibits the mucous membrane lesions of a
mmation. The inflammation extends more deeply,
ing particularly the connective tissue, but not entirely
cular fibres. From the inflammatory infiltration the
cosa become prominent, causing ridges to be formed,
ily felt on exploration by a sound. Small abscesses
ubmucous connective tissue or in the muscular coats.
commonly open into the vesical cavity, leaving diver-
slow to heal. Exceptionally such abscesses extend
ing the perivesical tissues and resulting in localized
or in peritonitis. If the active disease is arrested,
l cicatrization take place, producing more or less dis-
ntraction, sometimes sufficient to lessen greatly the

escribes a nodular, glandular cystitis characterized by
of small nodules disseminated over the bladder sur-
tubercles. These nodules are made up of vascular
arranged in circumscribed foci. He states that cys-
d by these nodules is extremely chronic, and subject
that pain and hemorrhage are pronounced.

CYSTITIS, variously described as exfoliative, croupous,
d desquamative, is characterized by the discharge
ethra or through a wound of the bladder of flakes,

masses, or complete moulds of the bladder, made up of fibrinous, structureless membrane containing the remains of l down epithelium.

Stein states that of fifty reported cases, forty-five occu women, and mostly in connection with labor or with serious troubles. The pathology seems to vary somewhat in differen Thus, Cabot, in practising suprapubic cystotomy, peeled off membrane composed almost entirely of epithelium. Adami ho true exfoliative cystitis is practically a necrosis of the inner la the bladder.

Gangrenous cystitis is characterized by sloughing of the and muscular coats of the bladder. It is occasionally noted i septic processes, in cancer of the bladder, and as a sequel to ex trauma.

Pericystitis is separately considered.

Symptoms of Cystitis.—There are no subjective symptoms point exclusively to cystitis,—pain, frequent micturition, and the urine, symptoms usually considered diagnostic of bladder- mation, being present when the prostatic urethra alone is invo

The symptoms of cystitis are—1, pyuria; 2, frequent uri 3, pain; 4, muscular spasm; 5, hæmaturia; 6, fever.

Of these symptoms pyuria is the only one which is constan

Pyuria.—This symptom is constant, and may be pathogn of cystitis. With pus there is frequently found blood, and always a superabundance of mucus and bladder epithelium. the urine is acid, there settles from it on standing a white sedi pus, and over this a cloud of mucus. When the urine is ne alkaline, particularly when ammoniacal decomposition has take there is often a viscid, ropy deposit of muco-pus. In chroni micturition may terminate by the expulsion of almost pure mu

Microscopical examination of the sediment shows abundan der epithelium, pus, often blood, micro-organisms, and in alkalin crystals of the triple phosphates.

Frequent Urination.—This symptom develops partly beca bladder-walls are abnormally sensitive to tension, partly beca prostatic urethra is inflamed and hypersensitive. Frequent u is aggravated by the erect posture, by bodily activity, by jol jarring, and by any of the causes which tend to increase con of the prostatic urethra. At times the patient is forced to mi every few minutes, and is absolutely unable to retain his wate the desire is felt; usually, however, it can be retained one hours.

t urination which so often accompanies chronic cys- when there is a mechanical obstruction to the free e, may occasion an enormous hypertrophy of the ılæ, with a sacculation of the weaker portions of the ng between these interlacing fibres. Bladders thus t difficult to cleanse of the ammoniacal urine.

s frequent urination and much straining, there may be uminuria due to congestion of these organs. Usually albumen in the urine is proportionate to the amount ıs which it contains. Exceptionally in chronic cases leakage through patches denuded of the surface epi-

in the acute cases is constant, with exacerbations of intense burning, with irresistible desire to pass nt straining (tenesmus). It is usually aggravated by ırition, and is more or less relieved after the bladder ceptionally, as in the case of stone and acute gonor- ystitis, the pain is most intense after micturition. It ostate and bladder, and radiates from there to the n, the sacrum, the rectum, the end of the penis, and surfaces of the thighs. In very acute cases when -cystitis the patient is compelled almost constantly to l most painful straining efforts at urination, with the ut a few drops of blood-stained water at a time

ısm.—As a result of inflammation reflex excitability ted. It is to the overaction of the sphincter muscles pain in cystitis is due. These are thrown into tonic phincterismus, thus increasing congestion and exciting as do the anal sphincters in acute proctitis. By their they resist the attempts of the detrusors to empty ding only after long effort, and then but partly, thus ıgury. Or the contraction may be so obstinate that retention of urine. Very frequently the tonic spasm onic contractions, which suddenly shut off the stream d, especially when the last few drops are being voided. y connected nerve-supply, the sphincter ani some- s in this tonic contraction, thus adding to the distress.

–The passage of almost pure blood, especially when end of urination, is characteristic of inflammation of thra rather than of cystitis. After micturition is com- ng may still continue from this region and flow back

into the bladder, rendering the urine alkaline and predis
to ammoniacal fermentation, with marked aggravation of th
From the bladder-walls in hyperacute cases there is usua
bleeding. This is slight, and the blood is intimately mixed
urine.

Fever.—In the beginning of an acute cystitis, fever and t
ciated symptoms of depression, nausea and constipation, are fr
observed.

Fever is, however, by no means an invariable symptom
it reaches a high grade, and is prolonged and is paroxysmal i
may be taken as a sign that cystitis is not the only cause.
cases a careful examination usually shows that either the pr
the kidneys are seriously involved.

Diagnosis.—Frequent urination, pain, and pus in the urin
themselves not enough to make the diagnosis of cystitis com

In cases of chronic inflammation there may be no sympt
cept pyuria. When, together with some or all of the sympto
above, the bladder is tender on suprapubic and rectal p
when the urine passed in three portions shows greatest
bidity in the last, when the flat bladder epithelium is very a
when intravesical injections show that the bladder is hyper
to tension, and when the urine at the time of being passed is
ammoniacal, the diagnosis of cystitis can be made confidentl

In many cases these characteristic features of bladder-ir
tion are not present. The diagnosis may then be made by cy
examination; or a soft catheter with a central terminal ope
provided with a broad elastic hollow flange just behind this
and so stretched over a carrier that the flange is obliterate
introduced into the bladder. On withdrawing the carrier
ticity of the rubber causes the flange to resume its shape. T
eter is then drawn out till the flange catches against the
vesical sphincter, and is secured in place by a small weight
to its free end. The bladder is thoroughly washed out with
salt solution, and the catheter is left in place for an hour, t
which flows through it being collected. It is obvious that
found in this urine must come from the bladder or the kidne
the flange effectually shuts off the prostatic urethra from the

Prognosis of Cystitis.—Provided there is no lesion which t
definitely to prolong vesical congestion, the prognosis of acut
is favorable. The inflammation which frequently accompan
or tight stricture of the urethra, or even enlarged prostate
completely cured by removal of the exciting cause. Cystitis

ugh instrumentation usually runs a rapid and favor- often happens, however, that some infection of the , which is stimulated to renewed activity whenever of the bladder is interfered with, or when sexual or or intercurrent disease causes pelvic congestion and cure is probably more often relative than absolute, dered established when micturition is accomplished ıen the urine is apparently clear.

nclusive proof of cure should be founded upon the scopic examination.

ıged sediment of twenty-four hours' urinary secretion ee from pus, the patient may be considered cured. ry, pus is found, even though it be in small quan- arcely enough to form shreds, some focus of infection d is liable to light up an acute inflammation under tances.

s of chronic cystitis is less favorable than that of the , however, absolutely bad. Surgical treatment of arged prostate shows that, after removal of the pre- bladders which have been inflamed for years, and ly dilated and atonic, may regain power and may ne healthy. This was considered the exception, at s, until recently. In fifty-two per cent., however, number of cases of prostatic overgrowth, subjected symptoms of a previously intractable cystitis disap- more favorable view may now be taken of the pros- tients. As a rule, though the active symptoms may ıay entirely disappear, some suppuration persists.

n that from infiltration of the bladder-walls, followed and contraction, the vesical cavity becomes greatly the bladder can contain but a few ounces at a time. particularly in the case of prostatics, there is dila- curably thickened suppurating mucous membrane.

to involvement of the kidneys, and consequently to atient, the prognosis of acute and chronic cystitis is ent.

es that the conditions favoring ascending infection ention and a strong, irritable bladder, which drives he ureter at the moment the orifice of this canal is its contents. These conditions are fulfilled in cases ertrophied prostate, acute inflammation, and spastic the first period of cystitis. The inflammation markedly increases the irritability of the yet strong bladder- Hence it would seem to follow that the greatest danger of ki fection from the bladder exists in the early stages of cystiti when the submucous and muscular coats are infiltrated vesical contractions are feeble, intravesical tension is not su high to overcome that exerted by the stream of urine descend the kidney. Tubercular cystitis, according to Lipowski, form ception to this rule.

Treatment of Cystitis.—From what has been said concer cause of cystitis, it is plain that the prevention of this disease upon the avoidance of local congestion and of the entrance into the bladder.

Local congestion is avoided by attention to the rules of Rest in bed is not desirable. Indeed, in cases of partial retention it seems to favor rather than lessen pelvic co Regular daily exercise in the open air, such as driving, wa riding the horse or bicycle, in accordance with the strengt patient, is to be commended. The diet must be so regula digestion is perfectly performed; even slight gastric or intest orders render the urine distinctly irritating.

Usually diluent drinks are serviceable, particularly at nig the urine is most strongly acid during the small hours. mineral waters may be ordered in accordance with the dys the patient. Thus, lithia water would be indicated in the rheumatic, ferruginous waters in the anæmic or in those su looseness of the bowels.

Careful attention should be given to the condition of t The patient should bathe daily in either hot or cold water, a to preference. This bath should be followed by vigorous The sweating-box described under the treatment of syphili ticularly serviceable, and may be used daily when there is syncrasy and when it does not produce weakness or debilit feelings of the patient will be the best guide in deciding on th of treatment. The sweat should be followed by a cool spon vigorous friction.

Regular evacuation of the bowels is a matter of cardinal tance. It has been shown experimentally that rectal obstru almost immediately followed by the appearance of enormous of colon bacilli in the urine, coming either through the ki conceivably directly from the rectum to the bladder through intervening walls. A daily bowel movement is best procure ercise and diet. If these means are not efficient, mild salin r, may be administered in the early morning, or rectal ıal saline solution may be given.

ion of the urine should be made to determine the ss of uric acid, oxalates, or other ingredients which the vesical mucosa and which can be lessened by and medication. Chilling of the surface, wet feet, ng, elaborate meals, highly seasoned foods, pastry, ınd rhubarb are to be avoided.

ıre local causes for reflex irritability, as hemorrhoids, ɔrepuce, or narrow meatus, these should receive ap- l treatment. Urethral causes of bladder-irritability ention of urine, such as stricture of either large or ɔuld be relieved as promptly as possible.

f preventing direct infection when this is threatened ımation of the urethra or of the prostate, or because ical interference, it is well to render the urine not even mildly antiseptic. This end may be accom- ɪdministration of salol, urotropin, or boric acid, as (five grains of salol, five to ten grains of boric acid, urotropin four times a day).

, or violent congestion typified by cantharidal poison- y hot baths, rest in bed, elevation of the pelvis, and ion of the lower bowel, best procured by salines and salt water.

f of the frequent painful urination belladonna and ies are indicated. These should be repeated hourly ɔlish the purpose for which they are given (extract alf grain; extract of belladonna, one-fourth grain). ns through a catheter by means of a piston syringe, y grains of antipyrin and ten to twenty drops of laud- n one-half ounce of water, are more useful and less than morphine or opium suppositories. Hot com- be applied to the entire abdomen, and should be tly. Diluents and sedatives should be given by the re cases leeches to the perineum and the hypogastric nely serviceable. If there is fever with consequent ine, to the copious draughts of water should be citrate or acetate, in doses of ten grains six times of nitrous ether in drachm doses hourly, or liquor may be administered in tablespoonful doses well e or two hours. Salol and boric acid should always purpose of rendering the urine slightly antiseptic.

When the symptoms are unusually severe, patients often ass
knee-elbow position, since thus the pressure of the abdomina
is taken from the bladder and venous engorgement is lessene
position is serviceable, and should be advised when it is n
taneously assumed. When large doses of opium fail to reli
and spasm, the ice-bag introduced into the rectum may be o

When the symptoms are purely the result of congesti
when there is no vesical infection—all intravesical mani
should be avoided, unless retention threatens, though it h
shown that pain may be relieved promptly and for several
the instillation of fifteen drops of a one per cent. solution of
In certain cases of gonorrhœal prostato-cystitis where the in
tion is limited to the prostatic urethra and the portion of the t
nearest the vesical orifice, an instillation of ten drops of a five
solution of silver nitrate will give almost immediate relief.

The bleeding of acute inflammation is usually slight, and
of advantage, since it lessens congestion; it requires no speci
ment.

Should retention supervene, if it is entirely due to sp
congestion, an attempt should be made to relieve it by a hot
bath, the patient being directed to micturate while still in
Hot compresses or turpentine stupes to the abdomen and f
of opium and hyoscyamus or belladonna are also indicated.
retention is complete and distention pronounced, there shou
hesitation in employing the catheter, ether being given if this
lation is excessively painful.

In the course of a week to ten days the acute inflamma
subside, and, provided there are no local conditions which
definitely to prolong congestion, convalescence may be c
Usually the disease becomes chronic, and may thus cont
years, giving rise to no symptoms other than a small quantit
in the urine, but being subject to acute exacerbations.

Treatment of chronic cystitis will not be successful unless
disposing causes, such as urethral obstruction, stone, and tu
removed. The diet should be so regulated that the food
oughly digested and the gastro-intestinal tract kept free fro
tion; highly seasoned articles, desserts, and alcohols are in
to be avoided. The natural mineral waters are useful as
and may be taken between meals. Saline diuretics—and amo
potassium citrate is the most valuable—should be given, well
in quantities sufficient to keep the urine nearly neutral in
In the absence of a rheumatic diathesis, and particularl

ciated anæmia, the ferruginous mineral waters are

ist of drugs used by the mouth comparatively few
alue. Urotropin and benzoic acid often do good
is markedly alkaline. They may be given in five-
s six times a day. The dose is regulated by the
rine. Acid sodium phosphate in half-drachm doses
is a useful drug for acidifying the urine and relaxing
balsams are extremely useful in both subacute and
Of these sandal wood oil is one of the best, given
apsule combined with oil of cinnamon.

℞ Ol. santali, ♏x ;
Ol. cinnamomi, ♏ii.
Ft. capsula i.

e such capsules daily, one hour after each meal, gradually
er.

e, the sandal wood oil must be given in full doses.
ossible, because of the gastric derangement it occa-

ic acid are valuable from their germicidal qualities.
to correct digestive disturbances rather than to pro-

other drugs which have been recommended and
only employed, perhaps the most useful are pichi
s every two hours in capsules; cantharides in drop
or two hours as a stimulant in extremely chronic
five to fifteen drops in emulsion every three hours;
five to ten drops in emulsion every two hours; fluid
or uva ursi in drachm doses every two or three
n doses of three to five grains three to six times

predisposing causes are removed, the bladder put
urine rendered unirritating, stimulant, and slightly
ammoniacal fermentation does not take place, the
y improve, and the patient recovers. If, however,
ienic and medicinal methods fail and free vesical
inues, local treatment is indicated. This may be
instillation or by irrigation.

f employing instillation has been described already
ent of posterior urethritis. Irrigations are practised
syringe fitted to either a short urethral nozzle or a

soft rubber catheter of comparatively full size. Irrigations
short urethral nozzle may be employed when the vesical to
good and the bladder has the power of completely and pa
evacuating its contents. In chronic cystitis this condition
tremely rare: hence the method of choice is usually that v
catheter.

Instillations are indicated when inflammation is particul
vere at or about the neck of the bladder. This is usually sh
the symptoms, strangury being always most pronounced w
flammation is thus located. These instillations act directly u
prostatic urethra and the neck of the bladder. They may
seem to aggravate tenesmus and pain, but this is shortly follo
marked relief. The solutions of choice are those of silver
with a maximum strength of five per cent. It is well to be
a one-half per cent. solution and gradually increase the stre
the symptoms are relieved.

Minet advises instillations two or three times a week of
four cubic centimetres of two per cent. aqueous solution of py
acid to relieve painful frequency of micturition.

Instillations are repeated every second, third, or fourth
accordance with the reaction they excite. The immediate pa
cause may be lessened by preceding them by an applica
cocaine. When it is desired to affect a larger surface of the
two to four drachms may be employed. The strength of th
solution when it is thus used should not be more than one p
When the treatment is inaugurated it is well to begin with
grain to the ounce. Silver nitrate instillations are particula
viceable in gonorrhœal cystitis, and in those chronic, non-tul
forms of inflammation which are not dependent upon ureth
struction and retention.

Sublimate instillations are useful in tubercular cystitis.
also render good service in the inflammation due to gonococ
bacilli, and ordinary pyogenic microbes. This method of tr
was first popularized by Guyon, who reported extraordinar
cessful results. The quantity injected into the bladder sh
from one to two drachms, and that into the posterior ureth
five to fifteen drops. Weak solutions are first employed (1 t
and the strength is gradually increased (1 to 500). These inst
may be repeated every second or third day, and should be p
by irrigations unless the bladder is extremely irritable.

Irrigations are given with strict attention to cleanliness. Th
tity injected varies in accordance with the capacity and irrita

It is a good rule not to inject a sufficient bulk of fluid to
n tension.

efficient irrigation is that of the silver salts. The solu-
varies in strength from 1 to 10,000 to 1 to 500. In
nic cases much stronger solutions than these are not
but are beneficial. The urine is first passed. The
irrigated with boiled water until this comes away clear;
two ounces of the silver solution are thrown in and
pe almost immediately. Strong silver irrigations are
or every second or third day, in accordance with the
ction. When they excite severe pain and apparently
toms,—and this is particularly likely to occur in tuber-
-other antiseptics should be employed. After silver
t efficient lotions are those of potassium permanganate
to 500, boric acid five to fifteen grains to the ounce,
to 1000 (made from an alcoholic solution containing
the ounce), and ichthyol one-half to two per cent.
weakest of these antiseptics occasions pain and marked
when it is certain that these sequelæ are not due to
n incident to the injection of too great a quantity at one
boiled seven-tenths per cent. sodium chloride solution
ed.

be clearly understood that in cases of chronic cystitis
ucosa is infected not only upon its surface but also in
that no antiseptic can reach germs which are embedded
The function of lavage is not to render the bladder-
ut rather to remove decomposing pus and urine, to
oy those germs which lie upon the surface, to stimulate
chronically engorged vesical walls, and to leave in the
duum which will prevent further fermentation of the
irritating effect upon the mucosa. It is therefore well,
ractised irrigation, to leave from half a drachm to an
ptic solution in the bladder. This is particularly indi-
acuation of the last few drachms of urine is painful.

n be given as to the number of irrigations which are
here there is profuse suppuration with rapid decompo-
ria, and retention, the bladder should be washed out
aily, and often this process can be advantageously re-
r four times. Where the cystitis is slight in grade and
t decomposed, irrigations may be practised every two or
aily irrigation at least is generally required.

pite of instillations and irrigations, or because of pain, spasm, and undue reaction, these methods of treatment practicable, the cystitis becoming steadily worse, and const symptoms developing, permanent catheterization is indicate technique of this method is fully described under the treat retention from prostatic obstruction. If the catheter is held in place, the bladder is constantly drained and thus pu Through this catheter are practised irrigations with the solutio excites least inflammatory reaction.

If these methods of treatment do not relieve the patient evident that his strength is rapidly failing from septic ab suprapubic or perineal drainage is indicated. Unless there distinct reason for choosing the suprapubic route, as, for insta necessity for operating on a vesical tumor or for treating a tu ulcer, the perineal incision should be the one of choice, except of vesical and prostatic tuberculosis.

When the cutting operation is forced on the surgeon in catheterization and irrigations, because of the pain and reactio they excite, forcible dilatation of the prostatic urethra is a portant procedure, since this will always for a time and of manently relieve the violent and exhausting tenesmus from w class of patients habitually suffer. The bladder is entered the membranous urethra. The drainage-tube should be calibre, about the size of the little finger, and its walls sh sufficiently rigid to prevent flattening from pressure of the The incision is packed with iodoform gauze, and the perine is attached to a rubber tube which passes beneath the surfa antiseptic lotion held in a suitable receptacle. The latter sh so arranged that it is always beneath the level of the bladde perineal tube secures continuous drainage and absolute r enables the surgeon to employ irrigations to the best effect.

PERIVESICAL INFLAMMATION.

Two forms of perivesical inflammation are described by cicatricial and the suppurative.

Cicatricial pericystitis is the result of chronic pelvic cellul is characterized by accumulations of sclero-adipose tissue a base and sides of the bladder. The perivesical tissue becom and greatly thickened, and firmly mats the pelvic organs The masses of this tissue, by forming about the vesical inse the ureters, may produce occlusion of these canals.

Suppurative pericystitis appears in the form of abscesses, ing in the normal fibro-adipose tissue surrounding the bladde

cesses are secondary to prostatitis or cystitis. It is
ey may form in case of wound or ulceration of the
ulceration may be tubercular or malignant. More
erosive, and is caused by stone or foreign body. The
arenchymatous cystitis may rupture externally and
esical tissues; usually they discharge into the bladder.
ricystitis due to stone ulcerating through the bladder-
d and develops slowly. It may discharge upon the
sually in the perineum, or empty into the rectum or
avity.

Abscess.—There is one form of perivesical inflamma-
m the fact that it is often primary and if promptly
be successfully treated, requires special consideration;
l suppuration, or abscess in the space of Retzius.
is entirely external to the peritoneum, and serves in
bladder room to expand and fill with urine. It is
orly by the pubis and the anterior layer of the trans-
f Cooper, behind by the posterior layer of that fascia
dder. That part of the space which extends upward
bis is limited above by the line of union of the two
which are given off at the lower border of the sheath
scles posteriorly, and has for its lateral limits the union
with the aponeurosis of the transversalis and oblique
w, the space is limited by the prostatic sheath and the
rosis of the true pelvis.

in this region may be caused by traumatism, oper-
ise, or by infection of neighboring organs, such as the
e, uterus, etc. Englisch, quoted by Thorndike, classes
vesical suppuration under three headings: (1) those
natism; (2) those caused by metastasis; and (3) those
t extension from neighboring organs or tissues.

from the boundaries of this space that pus may open
terior abdominal wall, into the rectum, the bladder or
rineum, or the peritoneal cavity. A certain proportion
give a tubercular history, but proof as to the causative
ubercle bacillus is wanting.

-The symptoms of prevesical suppuration are vesical
irritability, pain, not sharply localized, often referred
and associated with digestive disturbances, the forma-
r occupying the position of a distended bladder and
suprapubic or bimanual palpation, local tenderness,
stitutional symptoms of suppuration.

Diagnosis.—The formation of inflammatory infiltration beh pubis associated with symptoms of vesical irritability would absence of cystitis be sufficiently characteristic of prevesical mation. When cystitis is present the persistence of the tum thorough evacuation of the bladder-contents would also be pa monic. When the abscess points forward in the middle line, the only condition with which it is likely to be confused is pos suppuration, the pus then lying behind the rectus muscle tween it and the layer of fascia which descends directly to th In this case the pus would be limited laterally by the borders recti muscles and would extend upward. The induration of cal inflammation extends laterally beyond the limits of the re cles, and is usually symmetrically developed in the two side ceptionally the abscess extends towards one side only. W operated on one such case where because of associated in symptoms the condition was diagnosed as incarcerated hernia ful bimanual palpation suggested the true nature of the affecti the presence of pus was confirmed by an incision.

Prognosis.—This is favorable, especially when the cond properly diagnosed and treated by early evacuation of the p Englisch's thirty-three reported cases four died from a general peritonitis following perforation of the abscess into the pe cavity.

Treatment.—Suppuration requires evacuation and draina the absence of pointing, incision should be made in the mid directly over the pubis. Drainage should be secured by gauz ing. The same rule applies to all perivesical suppuration. should be evacuated as soon as it is detected.

In the treatment of that form of chronic perivesical inflan which is characterized by the formation of masses of fibro-lipo tissue attention should first be directed to the cure of the c which has produced or is keeping up pelvic cellulitis. This an untreated cystitis, with diverticula, or, in the case of women metritis and perimetritis. Hot rectal douches of normal sali tion and massage through the rectum and over the pubis serviceable.

TUBERCULOSIS OF THE BLADDER.

Tuberculosis of the bladder is a disease of early and life, occurring chiefly between the ages of fifteen and forty been observed, however, in children four or five years old, and noted a case occurring in a man at the extreme age of ninet re frequently in males than in females, and is usu- with tuberculosis of the seminal vesicles and of the

he predisposing causes have been found to be a gen- tendency, often inherited, together with an infectious y gonorrhœal in origin.

cause is infection with the tubercle bacilli. This e primary or secondary. The secondary infection ding or descending. Herberg, from the records of d autopsies, finds that genito-urinary tuberculosis is o-thirds of all cases, and that when it is primary it the sexual organs. Primary tuberculosis of the is most likely to attack the kidneys. Secondary y takes place directly from the prostatic urethra, ng that this gland is affected in ninety-three per cent. o-urinary tuberculosis, or indirectly through the ureter erculosis. Fournier holds that direct inoculation is coitus by tubercular mucus from the vagina entering a and infecting the bladder. An ascending infection ymis and vas undoubtedly occurs.

ble to say with certainty that a given case of vesical rimary; we must almost always remain in doubt as or absence of the disease in the kidneys. Frequently re may be demonstrated, but it may be present, and extent, without a single diagnostic symptom having When both bladder and kidneys are involved, it is termine, even by post-mortem examination, in which e was primary. Nor do the symptoms throw light on in the earliest stages of surgical tuberculosis, when it primary in the bladder, an examination may show the prostate and seminal vesicles, or renal hæmaturia the kidneys are already involved, although no symp- the implication of these organs have manifested

' The absolute absence of symptoms in the tubercular dney and ureter cannot be too strongly emphasized. indications are failure of the general health and an y pyuria, and even this may be lacking if the ureter edily obliterated. These diseases, therefore, at their even up to an advanced stage, are frequently not is only when the bladder becomes affected and the or cystalgia manifest themselves that medical advice

is sought. Often even then the attention of the physician is
directed to the dominating painful vesical symptoms, and he
attribute to the bladder alone phenomena which arise fro
lesions. Bearing these facts in mind, it will be found that
patients the urinary tuberculosis, considered as primarily v
prostatic, and classed among the ascending tuberculoses,
reality begun insidiously in the kidney. Autopsies support t
In many cases of wide-spread tuberculosis of the urinary t
possible to demonstrate the greater age of the renal lesions.'
concludes, "In a word, I am of the opinion that urinary tub
begins in the kidney oftener than clinical observation would
to suspect, and that it is especially a manifestation of genera
cular infection localizing itself in the kidney, which it reaches
of the circulation." It must be remembered that even th
kidneys are tubercular and constantly discharge tubercle b
bladder may remain entirely healthy.

Exceptionally, by the method of exclusion we can arrive a
nosis of primary, hence hæmatogenic, cystitis. The observa
Weigert, Heller, Weichselbaum, and others have shown that t
is one of the principal channels by which tuberculosis is pr
throughout the system. Pathological anatomy tends to con
theory. The initial changes are found to be grayish miliary
situated on the superficial layer of the epithelium. Ulce
always a later stage. Clado, having previously wounded th
mucosa of a rabbit, gave it a subcutaneous injection of tubercl
It developed vesical tuberculosis.

Among thirty-five cases observed by Casper, in three the
was found to be the sole seat of the disease. In fourteen
kidneys were also the seat of tuberculosis; in seven cases th
organs; in two cases the joints; in five cases the lungs;
cases general tuberculosis existed. In one case the patient
subject of lupus.

According to Koch, the following modes of infection
sible:

(*a*) *In the presence of tubercle bacilli in the body:* (1)
through the blood current; (2) infection by way of the lym
nels; (3) infection by the excretion of tubercle bacilli thr
kidneys with or without disease of these organs.

(*b*) *Through the introduction of bacilli from without:* (1) By
tation; (2) by catheterism.

PATHOLOGICAL ANATOMY.—In well-marked cases of tuber
flammation of the bladder there is a pericystitis, characterized

natous infiltration and degeneration; the bladder-walls
ind rugous. The mucous membrane is ecchymotic in
ations can rarely be seen, but when visible they appear
lots, sometimes confluent, but never in such masses
n the kidney. Ulcerations, either single or multiple,
the mucous membrane. Their edges are irregularly
ir base a greenish gray covered with thick pus. In
e very variable, sometimes only invading the mucous
l again they may even perforate the bladder-walls and
esical abscesses, or fistulæ opening into the rectum,
pogastrium; fistulæ, however, are rare. Microscopi-
n that the tubercular granulations arise in the super-
the mucous membrane, and in these lesions, which are
r near the trigonum, the tubercle bacillus and many
will be found.

–Vesical tuberculosis may develop so insidiously that
not suspected till a urinary examination, made in the
xamination for life insurance, for instance, shows the
In these cases there have been no symptoms, or
questioned, the patient will remember that he has
oubled by a somewhat frequent urination, chiefly after
ng the night. The urine is clear and limpid, is passed
so, and the frequency, which in children may cause
ntinence, is aggravated by the dorsal decubitus.

in many cases is an early symptom. The bleeding is
ous, and sometimes terminal, a few drops of pure blood
claret-colored urine. It often stops as suddenly and
it begins, and may not reappear for days or weeks.
becomes gradually less prominent as the disease pro-
eptionally there may be a profuse hemorrhage, but
urs the presence of vesical tumor should be suspected.

pronounced, usually denotes the onset of cystitis, to
ercular bladder is almost inevitably doomed. The
cystitis is catheterization, but it develops spontaneously
of instrumentation. Cystitis having been inaugurated,
one of the most constant, prominent, and harassing
he disease. The patient is tortured day and night by
urinate and by violent tenesmus, sometimes recurring
ites, and the pain may be felt at all stages of urination.
ns are most pronounced when the tubercular process
gion of the trigonum; when the lesions involve other
adder it may happen that an advanced stage of vesi-

cal tuberculosis will be reached before the slightest symptom
manifests itself.

Retention of urine occasionally results from spasm and in
tory obstruction of the internal urethral orifice, and again tru
tinence may arise from destruction of the neck of the bladde
tubercular process.

Pus is usually present, and if it contains greatly deformed le
and no micro-organisms is strongly suggestive of tuberculosis.
mixed infection the urine is limpid or at most faintly tinged wit

The method of staining the tubercle bacillus has been give
best ways of establishing its presence are by cultivation on
media and by inoculation of the lower animals. Many exan
and efforts at culture are often required before the bacillus is

In the female a painful zone of ulcerations may sometimes
at the meatus urinarius, extending thence up the urethra.

The general health suffers as is the case in tuberculosis
organs. There is loss of flesh and strength and, if mixed inf
present, there is also chronic septicæmia accompanied by feve
sweats, loss of appetite and often by diarrhœa. In such cases
is an important factor in producing deterioration of the genera

Diagnosis.—Probably in a large majority of cases tu
cystitis is not suspected till the disease is well advanced
spread wide of the bladder. Warren says,—

“Perhaps the reason that more than any other leads ge
nary tuberculosis to be overlooked is the readiness to rest
with a diagnosis of ‘idiopathic cystitis’ in cases in which
and irritable bladder are the conspicuous symptoms, and i
a few microscopic examinations of the urinary sediment fail
casts, renal epithelium, or crystals, the latter fact being c
sumed, under these circumstances, to free the kidneys fr
picion of being involved. ‘Idiopathic cystitis,’ in the ser
spontaneously occurring inflammation of the mucous memb
the bladder,—an inflammation without a well-defined cause
to say,—I do not believe exists. If inquiry is pushed far
some condition of which such as the following are th
familiar examples will be found to have originated the troub
orrhœa; stone; lithiasis; stricture; prostatic hypertrophy
consequences; the use of instruments; acute over-distentio
bladder, such as occurs sometimes in childbirth, or by v
effort, as with the insane; profound narcosis from opium or
the ingestion of certain irritating drugs, for example, canthar
connection with certain diseases of the spinal cord, etc.

ence of these or other well-defined causes, a patient cystitis, it is strongly suggestive of tuberculous dis- -urinary tract, probably located in the kidneys, the inal vesicles, or possibly in the bladder itself; but be rarely the starting-point of the disease."

at half the patients who complain of pus and mucus principal symptom are tubercular; it is certainly ercular cystitis is by no means a rare disease, and is frequently affected, apparently primarily.

thognomonic sign or symptom of tubercular cystitis of the bacillus in the urine. This is usually diffi- mpossible. Tuberculosis should, however, be sus- here is a characteristic family history; (2) there have ination and hæmaturia without discoverable cause; ps and persists in the absence of the ordinary pre- iting causes; (4) the epididymis, cord, prostate, or show signs of tubercular involvement; (5) there nptoms of tuberculosis in other parts of the body; apparently the only cause which can satisfactorily oms.

nosis in the event of failure to find tubercle bacilli be made by a cystoscopic examination. The find- ted or grouped tubercles, or of ragged, irregular, otic ulcers, will be conclusive. It may happen that are not typical, that the infiltrated rugæ may simu- that no lesion is found, though the bladder is un- lar.

his is generally bad, though the disease of the blad- elf fatal. There are nearly always foci in other urse of the disease is irregular, gradually growing generally due to renal or pulmonary involvement or tuberculosis. Yet cures have occurred, and no case the bladder should be considered hopeless.

essed eight cases of complete recovery from a tuber- ection. One patient was curetted and five per cent. vas instilled; another was treated with instillations ichloride solution. The others recovered without fter removal of the tuberculous kidney by nephrec- ion by obliteration of the ureter. In two cases the severe that recovery had been considered hopeless. ed abundant tubercle bacilli.

vesical tuberculosis is recognized in its early stages, before the onset of cystitis, minute attention to general hygie ful avoidance of the causes of vesical congestion, such as constipation, or resisting the desire to urinate, and the admi of salol and boric acid in small doses (three grains of ea daily), for the purpose of keeping the urine antiseptic, rep that should be done, aside from the administration of to tissue-builders, such as preparations of cod-liver oil, and a climate when the patient's circumstances will admit of this.

It is particularly important to avoid instrumentation at of the disease. It has already been shown that, because of stantly infected condition of the anterior urethra, it is imp introduce an instrument into the bladder and be absolute that its tip is sterile. Infection once started is practically and not only introduces the element of pain, but markedly the extension of the tubercular process: hence the passage strument simply for the purpose of exploration is contra-in

If, however, there is strong reason to believe that t cular infiltration is primary in the bladder, has not exte yond this viscus, and can be entirely removed by opera passage of a cystoscope for the purpose of corroborating t might be permissible, but only on condition that the surge pared to follow this ocular examination by immediate opera ducted for the purpose of entirely removing the seat o Unfortunately, we can never be certain that tuberculosis limited to the bladder, and we know by statistical study th limited in but a very small percentage of cases. Hence th nation, though theoretically desirable, is practically not to mended.

When cystitis has developed, the same strong reason ag introduction of a sound, catheter, or cystoscope does not obtai the bladder is often extraordinarily irritable, and a violent may be excited by the most gentle instrumentation.

The treatment of cystitis is conducted in accordance with ciples already laid down. Medicines are administered by t which render the urine bland and exert a stimulating, hea antiseptic influence upon the vesical mucosa. The severe violent tenesmus are best allayed by suppositories of o belladonna or hyoscyamus or by rectal applications through by means of a piston syringe, of fifteen to thirty grains of anti ten to twenty drops of laudanum dissolved in one-half ounce

Albarran and Cathelin advise epidural injections of one-s of cocaine in normal salt solution.

ment must be conducted with great care. We have stillation of a five per cent. solution of silver nitrate pain and tenesmus which confined to bed for weeks il this was given had been comparatively comfort- silver nitrate is unsuited to these cases, and this fact that a prolonged and violent reaction following its gest the tubercular nature of the inflammation.

cessful treatment yet reported is that of instillations curic chloride, suggested and practised by Guyon. of 1 to 5000, gradually increasing the strength up e reaction excited is usually slight and transitory. vere and lasting.

hould be entirely empty. This may require the use that case the instillation should be made through When the urine contains a large quantity of viscid revent the medicament from coming directly in con- ucous membrane: hence, unless there is extreme illation should be preceded by lavage, great care oid painful tension from injection of too much of ne. The bladder having been emptied and cleaned, s to two drachms of the corrosive chloride solution re allowed to remain in the bladder. The initial wenty drops of a solution of ·1 to 5000. The quan- are increased carefully, the surgeon being guided in degree of the pain and reaction which are excited. place the eye of the catheter or the nozzle of the hin the grasp of the compressor urethræ muscle, so rostatic urethra may be washed by the instillation, lways accompanied by inflammation of this portion ucous membrane.

is repeated daily, or every second or third day.

a ten per cent. mixture of iodoform in glycerin or employed, apparently with beneficial effect.

Banzet, twenty-nine cases treated entirely by sub- s were cured. Another favorite treatment is the after cleansing or curetting the ulcer of five per cent. oil. To this may be added one per cent. iodoform. o twelve per cent. watery solutions of thallin sul- ended by Keyes.

articularly indicated when the pain and urgency be- and are not controllable by safe doses of narcotics. mstances there will often be infiltration of the pros-

tate and seminal vesicles: hence complete eradication of th
will be no longer practicable. The operation is then perfo
measure of relief and not as one of cure, the bladder bein
through either a perineal or a suprapubic opening. Often t
age gives immediate and complete relief. Sometimes pain a
mus persist. The suprapubic cystotomy is to be preferred,
bladder is more liable to be opened at a point somewhat
from the most active region of the tubercular process. A
wound is very apt to become infected, whereby troubleso
are formed.

The suprapubic operation also possesses the advantage
ing the surgeon to inspect the interior of the bladder and to
rectly intravesical lesions. These may be thoroughly cur
well rubbed with iodoform, or may be destroyed by the a
of the actual cautery. Following these procedures there are
ported cases of cure. Were tuberculosis more often confin
bladder, this form of intervention would promise brilliant r

Having opened and drained the bladder above the pubis
stroyed or removed tubercular ulcers, the vesical mucosa i
clean as possible by irrigations with normal salt solution o
antiseptic, provided it does not excite too much reaction. S
as a result of this treatment cystitis is cured and the tuberc
cess appears to be checked, the suprapubic opening closin
moval of the drainage-tube. There is, however, a constant
the abdominal wound may re-ulcerate and break down an
dominal hernia be the outcome. In less favorable cases th
the drainage-tube often becomes tubercular.

During the whole course of local treatment the impo
general hygienic measures must be remembered.

Tuberculosis of the bladder generally heals after nephrec
it fails to do so within a year under ordinary treatment and if
pying more than half the bladder-wall, it should be excised. (

SYPHILIS OF THE BLADDER.

Margulies reports three cases of syphilis of the bladde
terized by marked cystitis and persistent hæmaturia, in one
cystoscopic examination disclosed tumors resembling carcin
rounding one of the ureteral openings, in another a small ul
base of the bladder, in another diffuse cystitis; all were a
with the history and signs of tertiary syphilis and all were
antisyphilitic treatment.

Diagnosis is made largely by exclusion. In the presence o

with hæmaturia, and the cystoscopic picture of either
or gummatous cystitis stubborn to the usual treat-
ith the history and signs elsewhere of tertiary syph-
nay be suspected.

s are not sufficiently characteristic. All other causes
and ulceration and vesical tumors must be excluded.
se is cured by energetic antisyphilitic treatment.

FISTULA OF THE BLADDER.

a is an ulcerating tract leading from the bladder to
e body or to some neighboring viscus. It is usually
of a surgical or an accidental wound to heal, but may
sion from a calculus or foreign body, burrowing of a
s, or ulceration of a tubercular or malignant infiltra-
ous tract may run directly or deviously to the skin
orm a communication between the bladder and the
ale genital tract. The nomenclature of these fistulæ
heir course: thus, they are termed vesico-perineal,
c, vesico-gluteal, etc. Pathologically these ulcerating
ntical with urethral fistulæ; they may burrow in
and open by several orifices; they often develop
rticula, and they become densely indurated.

ystitis is a symptom common to all forms of long-
fistula. Other symptoms vary in accordance with
extravesical opening. When this is upon the skin
n obvious escape of urine.

ay dribble almost constantly or may flow intermit-
e tract is narrow, and particularly when the open-
valvular, the quantity escaping will be insignificant.
the reverse of these obtain, all the urine may pass
rmal opening. The skin surrounding the external
stula shows the excoriation, inflammation, and infil-
when treating of urethral fistulæ. During the act
r when intra-abdominal pressure is increased by
tion, as in the act of lifting, coughing, or defecation,
l flow of urine from the opening.

tula opens into the rectum, if the channel of com-
arrow, there may be no symptoms suggesting this
ther than a urinous discharge occurring with the
well-formed stools. Usually, however, the symp-
la are sufficiently characteristic. There is a more
escape of urine from the rectum, and gas and fæces

are passed by the urethra. We have seen a case due to ca the bowel, in which nearly all the fæces were passed by the ure several months. Fæcal masses, by blocking the urethra, ofte retention of urine. Cystitis under such circumstances is very

When there is communication between the bladder and th intestines or the colon, in the latter case usually by way of pendix, gas, remnants of food, and traces of bile will be pas urethram, but the solid particles found in the urine probably exhibit the characteristics of fæces. There will be no urine by the rectum, or none which can be recognized as such, si thoroughly mixed with the rectal contents.

Diagnosis.—When the fistula opens externally the diag based on—1, escape of urine, particularly marked during ab straining; 2, escape of colored fluids injected into the bladder or lene blue by mouth; 3, urethral examination, a sound being pas the bladder and a fine probe being introduced along the fistulo 4, cystoscopic examination; 5, injection of hydrogen peroxide a fistulous tract, bubbles then escaping per urethram at the ne micturition; 6, palpation, an area of induration sometimes be ceptible from the external opening directly to the bladder-wal

When the fistulous opening is tortuous and narrow, exp with a probe is, of course, impossible.

When the fistula opens into the bowel the diagnosis may difficult. The passage of air at the end of micturition and bubbling sound is in itself pathognomonic. The detection ments of partially digested food or of fæcal masses in the u finding of urinary salts in the liquid passed per anum, the tion of an opening into the rectum by direct examination th speculum, the finding of a bladder-opening by the cystosc particularly the discovery of a sufficient cause for such a le for example, malignant or tubercular ulceration, or large ston pendicitis, would lead to a correct diagnosis. Colored solutio as methyl-blue, if injected into the bladder, may appear in th or if administered by mouth will appear along the fistulous tr positively establishing the existence of a vesico-rectal fistula.

The differential diagnosis between vesical and urethral based upon the fact that urine escapes from the latter only d after micturition, and that colored fluids injected into the blad not escape through the fistulous opening until the patient urin

Treatment.—Fistulæ due to tubercular and malignant in and ulceration are incurable. The appropriate treatment is rected against the cystitis. Perineal or suprapubic drainage ıla following stone operation, if small and comparatively : cured by continuous catheterization, combined with ing of the bladder and cauterization of the fistulous y with the galvano-cautery. If after this treatment sists, permanent catheterization continued for two or ay be tried. This failing, the fistula should be laid dder, its walls dissected out, and the wound treated as er the operation of lithotomy.

fistula opens in the gluteal region or in the neighbor--joint, after a preliminary effort at closure by catheter- perineal lithotomy should be performed, and the be drained immediately through this opening.

-vesical fistulæ not due to tubercular or malignant in-eated on the same general principles. At first cathe-d be tried, combined with cauterization of the fistulous ne rectum, after which a permanent catheter should be patient in ventral decubitus.

if the tract is extraperitoneal,—that is, if it lies below ıl peritoneal fold,—it may be operated on as described t of urethro-rectal fistula.

istulous tract is intraperitoneal and when it persists in iative means described, a formal operation is indicated, ıte outlook of these cases if untreated is absolutely bad, from ascending nephritis. Immediately preceding the ladder should be thoroughly irrigated with dilute anti-bly corrosive mercuric chloride 1 to 5000 containing per cent. of carbolic acid. This is followed by irrigation : 1 to 500. The peritoneum is then opened just above communication between the bowel and the bladder is sible, and the intraperitoneal operative area is packed neral peritoneal cavity by gauze sponges; the bowel is loose, the opening into it is closed by Lembert sutures, er-wound is closed by a double row of catgut sutures, ıous and including all its coats except the epithelial ıucous membrane, the second interrupted (Lembert) only the peritoneal, muscular, and submucous invest-peration is always dangerous, since the bladder is ted, and peritonitis may result.

treatment the bladder is drained for from three to five nent catheterization, and is irrigated twice daily with : nitrate 1 to 2000, boric acid four per cent., or salicylic er cent.

CHAPTER XII.

CALCULUS OF THE BLADDER.—TUMORS OF THE BLADDER.

Vesical calculus is a concretion of the solid urinary con of such size or so placed that it does not escape through the passages, but remains in the bladder.

Calculi may be generally grouped under the following hea

1. Those formed from the normal constituents of the uri acid, the phosphatic, the mixed, and the urate calculi.

2. Calculi formed of salts found in normal urine, but neve in excess except in disease,—the oxalates and carbonates.

3. Concretions formed from elements entirely foreign t urine,—cystin, indigo, and xanthic oxide.

The large majority of stones are formed of uric acid urates; the phosphatic and mixed calculi come next in frequency; and last come the oxalates and rarer forms,- xanthic oxide, etc.

Uric acid calculi are formed in acid urine. Originatin pelvis of the kidney, they descend through the ureter to the usually causing that form of violent and paroxysmal pain termed renal colic. Once in the bladder their further growt to accretion of uric acid alone, or they may form nuclei fo position of other elements. Uric acid calculi are generally spheroidal, moderately hard, and yellow to reddish brown in

High living and a gouty diathesis are factors predisposin formation of these concretions. They occur at the extremes

Urate Calculi.—The sodium, potassium, and ammoniu though rarely forming large stones, are constantly and copic posited as sediment in febrile affections, and when from a the urine becomes markedly concentrated. The urate calcul served almost exclusively in children. In the adult they the nuclei of large concretions made up of divers elements are grayish yellow in color.

Phosphatic calculi follow the uric acid and urate concr order of frequency; there are three varieties.

1. The amorphous calcium phosphate rarely forms a cal itself. It is commonly deposited in layers about calculi of ot

gled with them, sometimes reaching considerable size. sily; its color is a dirty brown or white.

le phosphates (ammonio-magnesian phosphates) are alculus formation than calcium phosphate. Such callline and of a whitish color. Formed in ammoniacal are vesical in origin and frequently complicate cystitis. isible calculi, being composed of the triple phosphates osphate, are not uniform throughout, forming about a ium oxalate, uric acid, foreign bodies, etc. They ap- which resemble white friable mortar, and are formed urine.

ALATE CALCULI, like those of uric acid, are of renal ori- most frequently in patients suffering from oxaluria, a ated with indigestion and neurasthenia. These are the stones, and are usually small or of medium size, sphe-, dark brown or black in color, and have a tuberculated rise to the name of mulberry calculus. Amorphous osphates are often deposited between the tubercu-

BONATE CALCULI are rare. When found they have been, weighing from thirty to forty grains each, and hard structure, similar to the calcium oxalate calculi.

CULI.—Cystin as a major constituent of calculus is ex- As is the case with the uric acid and calcium oxalate concretions originate in the kidney. In appearance lar and knotty, sections showing no attempt at crystal- and yellowish white at first, but turning to green after o the air.

another rare constituent of calculus. Indigo does not in itself, but may be so important an ingredient that ne its typical color. It occurs in cases of liver disease cystitis.

s named from its preponderating element, but usually one salt serving as a nucleus, with layers of different osed. Thus, the phosphatic calculus is often found to ntre a minute concretion of calcium oxalate or uric olving out the salts of even the smallest calculus there n albuminoid or colloid framework upon which these d, and which serves to agglutinate the mass. Rainey demonstrated the tendency of crystalline salts when in olloid or albuminoid substances to assume rounded or ns in crystallization. It is certain that the development

of stone is not wholly due to the mere presence of an excess o
the urinary salts, for copious deposits of uric acid and the ph
may exist for years without any evidence of calculus formati

If, however, at a time when the urinary salts are in exc
renal or vesical irritation is lighted up, by means of which bl
serum are intermingled with the urine, furnishing an albumin
stance which favors the agglutination of the small crystals, cal
form, and, once formed, tend to increase in size.

Vesical calculi, when free, are usually spheroidal. They
irregular from multiplicity and erosion, or from having been
in a diverticulum or in the prostatic urethra. Ord holds tha
split spontaneously because, incident to changes in the specifi
of the urine, the colloid framework becomes swollen by ab
of a liquid of different density, and the concretions fracture a
lines of deposition upon this framework.

Etiology.—It is evident that for calculi to form two mai
are requisite: first, a diathetic tendency to over-eliminatio
urinary solids which form the basis of calculi; and, second, lo
ditions which cause these solids to conglomerate.

The diathetic tendency is strongly marked in certain l
but these are so wide-spread, so totally different in climate a
roundings, and the diet and habits of the people so differ,
general law can be deduced which bears on calculus formatio

There is a popular belief that a limestone soil which f
hard drinking-water predisposes to calculus; but, although
ease is quite common in many limestone districts, it is equa
mon in sandstone districts; moreover, there is no reason
ingestion of lime should cause uric acid deposits. Vesical ca
found in cold as well as in warm countries; for instance, in S
China and in Northern Scotland. They are more frequen
central United States than in New England and the Souther
and one section of a single State may furnish more cases than

Urinary calculi are found from extreme youth, even in t
bladder, to old age.

In the statistics of Civiale, Coulson, and Thompson, compil
10,467 cases, 62.33 per cent. occurred in persons under twen
of age; these cases were taken from hospital patients repr
the poorer classes. Sir Henry Thompson, in a series of priva
numbering 798, operated for vesical calculus 93 times in
between the ages of sixteen and fifty years; 527 times in
ranging between fifty and seventy; 175 times in patients over s
and but 3 times in patients under sixteen.

s that calculi are so frequently found in hospital and e in patients under twenty years of age because of the urroundings, irregular diet, and malnutrition of chilver walks of life.

s for more than sixty-six per cent. of his private calbeing over fifty years of age on the ground that the ddle classes of society are predisposed to the uric acid the age of fifty, because then vital activity diminishes, tly comes the desire for rest and a sedentary life, withrate lessening of the quantity and variety of food inuld therefore seem that insufficient clothing, lack of ment, and improper hygienic surroundings among chilse to calculus-formation, while among adults the same ced by conditions of a very different character.

e difference in the length and dilatability of the male urethra probably explains the greater frequency of cal-A small uric acid stone reaching the female bladder ency to linger there, the short, wide urethra allowing hout producing even a sensation of uneasiness. The observed in women are usually incrustations about a The proportion of calculi found in the female bladder the male bladder is about one to twenty-two.

–Preceding the formation of a stone there may have of gravel, of oxaluria, of heavy deposits of urates. e is of uric acid and is formed in the kidney, lumbar ria, and renal colic often precede its arrival in the nay, however, reach this viscus without exciting the om.

ched the bladder, the stone acts as a sterile foreign g irritation and congestion, and thus favoring the decystitis. Frequent micturition, pain, hæmaturia, and nces are the prominent symptoms.

rination.—This symptom is most marked in the dayravated by motion, and relieved by rest. The desire nes suddenly and is almost irresistible. The patient lled to urinate every two or three hours, or in some ery few minutes. The act of urination is often acmuch tenesmus, in which the rectum participates, so of the bowel, particularly in children, is by no means small stone irregular in shape produces a more aggran of frequent urination than a large, smooth calculus. or adherent stone, or one which lies at the base of a

bladder so changed in shape that the calculus is not liable to
contact with the vesical neck, will often give rise to no mar
quency of urination. It is to be noted that frequent urinat
symptom of so many other bladder conditions that in itself
not necessarily suggest the presence of stone.

Exceptionally there is sudden stoppage during the passa
full-sized stream. This is observed chiefly in young persons
patients having small stones, since it is due to the dropping
of the calculus into the vesical orifice of the urethra. It is ex
suggestive of calculus if it can be obviated by the patient urin
certain positions, as, for instance, when lying on the back.
frequent micturition, sudden interruption of the stream is a s
of inflammatory troubles of the vesical neck, and is not pa
monic of stone.

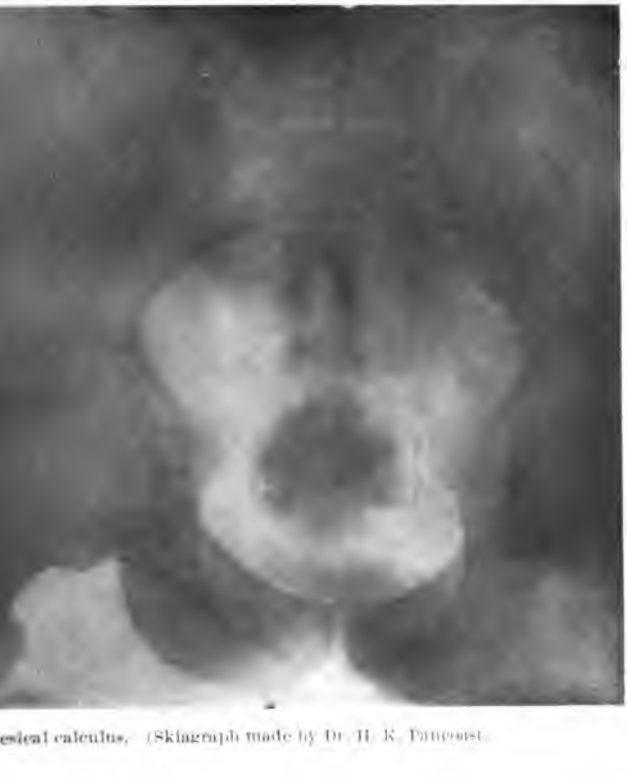
Pain.—The pain of vesical calculus is usually referred
lower urethral surface, about an inch posterior to the glan
burning and stinging in character, and is less pronounced in
than in children, prostatic enlargement in the former preven
calculus from coming in contact with the vesical neck.

Pain is most marked at the end of urination, because t
inflamed mucous membrane is brought in direct contact
stone. The intensity of pain varies proportionately to the d
cystitis and the size and nature of the stone, and is intens
jarring motions and by change in position. Small stones, es
if they are rough, cause more suffering than do large ones. A
of pain pronounced during the early stages of stone, and g
lessening, suggests that a small rough stone has become cover
mucus or with phosphatic deposits, thus forming a smooth
A stone may be carried for years without exciting the slightes

Hæmaturia is of importance only when associated wit
symptoms. It is caused by the mechanical friction and scrat
the calculus, and is most pronounced when the bladder is co
as in cystitis. It is markedly aggravated by motion. The
most apt to be voided towards the close of urination.

Reflex Disturbances.—Priapism has been noted as a refl
ticularly in children; in them it may lead to the practice of
bation, since pain is referred to the end of the penis, and
commonly pulling and handling of that organ in instinctive e
obtain relief. Reflex pains felt in the rectum, the perine
hypogastric region, the small of the back, and on the outer su
the thighs, the lower leg, or the foot, are frequently noted.
a peculiar pain in the foot, known as podalgia, which is so

Fig. 135.



esical calculus. (Skiagraph made by Dr. H. K. Pancoast.)

symptomatic of stone; it is frequently located in the neighborhood of the ball of the great toe, but may extend over the whole sole. It is most commonly observed in the gouty and rheumatic. It disappears as soon as the calculus is removed. Pain may also be felt in the upper extremities of the lungs.

Rectal prolapse, hemorrhoids, and subconjunctival hemorrhage, though not absolute in their significance, may aid in diagnosis, since they are symptomatic of the violent straining efforts which frequently accompany the act of urination.

True inflammation of the bladder is likely to occur sooner or later, though some cases of stone may last indefinitely without this complication. It is usually caused by instrumentation; but the intervention of this agency is not necessary for its development. It aggravates the symptoms already given, and causes a heavy deposit of muco-pus in the urine.

Diagnosis.—The diagnosis of stone is founded upon physical examination. The symptoms above described, either singly or altogether, may be excited by any inflammation or irritation at the neck of the bladder independent of its cause. Pain referred to the under surface of the glans penis and felt most acutely at the end of urination, sudden interruption of the full stream, relieved by change of posture and not occurring when certain postures are assumed, and hæmaturia, can be considered only as strongly suggestive of stone and as calling for direct examination.

A vesical calculus may excite no symptoms. Morris records the case of a man who, at the age of sixty-six, learned by an attack of hæmaturia that he had vesical calculus. This patient died after thirteen years, of carbuncle of the neck. He never had a bladder-symptom, and his first attack of hæmaturia was also the last, although he never submitted to operation.

The examination is conducted—1, by bimanual palpation; 2, by intravesical exploration with instruments, including (*a*) stone-searcher or sound; (*b*) lithotrite; (*c*) evacuator attached to aspirator; (*d*) cystoscope; 3, by direct examination of the bladder through either a perineal or a suprapubic opening; 4, by X-ray examination.

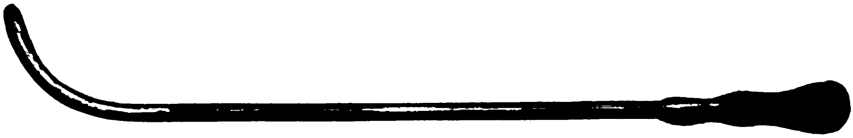
1. Bimanual palpation is thus practised in the male: the patient having passed his water is directed to lean well forward over the back of an arm-chair, for instance, with the legs moderately separated and the abdominal muscles relaxed. The surgeon then introduces one or two fingers of the right hand into the rectum and with the four fingers of the left hand presses upward and backward, directly over the pubis, towards the base of the bladder. In place of standing,

the patient may lie on his back, the head and shoulders elevated, the thighs flexed; the right and left hands are used as just described. In thin subjects and in those with not too muscular abdominal walls, the presence or absence of calculus of even small size can be readily determined.

In the female examination is made through the vagina, the bladder being palpated by the ordinary bimanual manipulation.

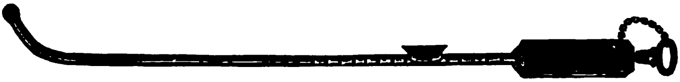
2. Instrumental exploration is inaugurated by passing a stone-searcher. The requirements of a satisfactory vesical sound or stone-searcher are that it should have a straight shaft fully ten inches long, and a short curve near the tip. Two instruments should be provided, one with a very slight curve, the other with an abrupt curve, permitting it to be carried into the pouch behind the prostate. The calibre should be about 13 F. (Fig. 136.) It is desirable to begin the examination with the bladder fully distended, and to allow the urine gradually to escape, the search being continued. For this reason, and because it allows of an approximate estimation of the size of the stone, Thompson's stone-searcher is particularly serviceable. (Fig. 137.)

FIG. 136.



Stone-searcher.

FIG. 137.



Thompson's stone-searcher.

The solid steel sounds shaped as already described, and provided with flat handles, are the instruments of choice.

These sounds are passed with the patient in a recumbent or semi-recumbent position, with shoulders raised and thighs flexed and separated. Should cystitis not be present it is particularly important to conduct all manipulations in accordance with the rules already laid down for antiseptic instrumentation of the urethra and the bladder, since it is now universally recognized that the passage of instruments is probably the most prolific cause of bladder-infection. The instrument, having been sterilized and lubricated, is introduced without difficulty if the operator remembers that its curve does not correspond with the fixed curve of the normal urethra; at the time the extremity of the instrument traverses this region downward pressure must be made with the fingers on each side of the penis, so as to elongate and straighten out the urethral curve. Even after the sound has traversed the membranous urethra it is often arrested at the internal vesical sphincter, and when in this position a comparatively roomy prostatic urethra may allow of some degree of lateral motion. It is important to remember that the sound is not satisfactorily introduced into the adult bladder unless at least eight inches of the straight shaft have been passed, and that when it has properly entered it can be easily rotated almost, if not quite, around its long axis.

The bladder having been entered, the cavity of this viscus should be systematically explored. The sound is partly withdrawn and pushed back again with comparatively rapid motions, the handle being elevated and depressed. The withdrawal is at no time sufficient to engage the curve of the instrument in the prostatic urethra. The back of the sound should then be turned towards one side of the bladder, and the point, directed towards the opposite side, should be made to traverse the arc of a circle, sweeping transversely through the bladder from above downward. This motion, begun with the inner end of the sound at the bas-fond, is continued while the sound is gently drawn outward until the curve reaches the vesical neck. It is then pushed in again until the posterior wall of the bladder is touched. The point is now turned to the opposite side and the same manœuvre is repeated. If the stone is not found in this manner, the searcher is again introduced to its full length, and the tip is turned gently towards the floor of the bladder, and rotated quickly from side to side, while the instrument is gradually withdrawn until its curve catches the vesical neck. The anterior wall of the bladder may be explored by pressing it down by suprapubic pressure till the tip of the instrument can reach its surface. Where there is an enlarged prostate and the base of the bladder is depressed, it is well to elevate this portion of the viscus by a finger introduced into the rectum, while the exploration with the sound is continued.

If these manipulations fail to detect the stone, the urine should be gradually withdrawn, and as the bladder contracts they should be repeated. Thompson's searcher should be used under such circumstances.

The presence of stone is denoted by a distinct click, which can be both felt and heard. The feeling is that of a sound coming in contact with a hard body, the click like that of a piece of metal striking the sound. It is important to bear in mind that this click should be heard and not merely felt. The attachment of sounding-boards or of tubes to the searcher is of no practical help to the surgeon himself, though both are useful for class demonstration. Suprapubic auscultation is said to be helpful.

The size of the stone may be estimated by a searcher provided with markings on its shaft and with a sliding collar. (Fig. 137.) By passing this collar to the meatus after the stone is first touched, and then marking the point at which the sound ceases to come in contact with it as it is slowly withdrawn, the diameter of the stone may be determined, this being, of course, the distance between the collar and the meatus.

The surgeon may either fail to detect a stone which is present or imagine he has detected a stone which is not present. Failure to detect a stone which is present may be due to—1, the more or less encysted condition of the calculus, leaving little or none of its surface exposed; 2, the presence of a diverticulum with a very small opening containing the stone; 3, the fixation of the stone to the summit or the anterior wall of the bladder by adhesions; 4, the covering of the stone with lymph or blood-clot; 5, the lodgement of the stone in a deep post-prostatic sinus or between the lateral or upper walls of a prostatic overgrowth and the vesical mucosa; 6, failure to enter the bladder with the sound, the prostatic urethra being dilated and the vesical orifice of this canal being obstructed by prostatic overgrowth.

The surgeon may believe that he has detected stone when none is present from—(1) incrustation of a tumor with lime salts; (2) a fasciculated condition of the bladder, especially when associated with ulceration and partial incrustation; (3) possible bony growths developed from the pelvis; tumors; fæcal impaction in the rectum; and undue prominence of the promontory of the sacrum.

Examination by the lithotrite is of advantage in enabling the surgeon to determine the exact size of the stone, to ascertain whether or not it is adherent, and to make a rough estimate of its hardness. As a means of simply detecting the stone it is no more serviceable than a stone-searcher of similar curve, and is more difficult of manipulation.

The evacuating-tube attached to an evacuator is probably the best stone-searcher if the calculus is very small. As the liquid in the evacuator is driven forcibly in and then aspirated, the small calculus will be brought against the opening of the catheter with a sharp and unmistakable click. It should be noted that if the eye of the tube is carried too near the vesical wall this will be sucked in and will give a jarring sensation, or if the joints of the instrument are loose there may be produced a sound which will closely simulate the click of a stone. This instrument is useless when the stone is encysted or adherent.

An examination with a cystoscope is of service as a means of finding stones which cannot be reached by the sound, corroborating diagnosis, determining whether a stone is adherent or encysted, and discovering the condition of the vesical mucosa.

Because of the thoroughness with which the bladder can be explored by the cystoscope, direct examination through a perineal opening will be rarely required, even in obscure cases, except when the stone is encysted or when the concomitant disease of the bladder is so inveterate and pronounced that prolonged drainage is indicated. In such cases the stones are usually encrusted with phosphates, and should be detected by skiagraphy. The suprapubic route is the one of choice when an incision is required for diagnostic purposes.

It is apparent that the diagnosis of calculus is founded solely on direct examination.

Aside from containing a small quantity of blood and perhaps an excess of deposits, the urine may remain for a long time normal. Stone in itself will not cause cystitis. It simply predisposes to infection. When infection has taken place, often from the introduction of a sound or other instrument into the bladder, all the symptoms are aggravated. Pain becomes more severe and constant, frequency and urgency of urination are more pronounced, bleeding is freer, and tenesmus is more distressing. It is, however, clear that these symptoms are indicative rather of cystitis than of stone.

Prognosis.—A vesical calculus may, in the absence of cystitis, from the frequency and difficulty of micturition, cause hypertrophy and thickening of the bladder-walls, dilatation of the ureters and kidney pelves, and a chronic congestion of the whole urinary tract, strongly favoring infection. Cystitis once started is constantly aggravated, and may extend deeply. Exceptionally the calculus ulcerates through the vesical walls, forming a pericystic abscess.

Royden records the case of a man aged sixty-four years, who suffered from intermittent hæmaturia for ten years. There were no other symptoms. Finally repeated sounding caused cystitis. After a few attacks of severe pain he passed some fragments of stone. Following this, the urine became normal and he regained his health. Shortly cystitis again developed, and was characterized by tenesmus and pain referred to the end of the penis. The patient suddenly became collapsed, with distended abdomen and all the signs of peritonitis. Autopsy showed that a diverticulum containing a number of concretions had ruptured, allowing the urine to escape into the general peritoneal cavity.

From constant engorgement the prostate slowly enlarges, and, by obstructing the outflow of the urine, favors retention, with reflux of septic fluid into the ureters and kidney pelves, and consequent pyelonephritis. Hence the prognosis of untreated calculus is grave.

Morris states that if, after years of comfortable life with a stone in the bladder, painful symptoms should necessitate an operation, the patient is only too likely to succumb from suppression of urine or from suppurative pyelonephritis, because the ureters are usually greatly dilated and the renal tissue atrophied. He also calls attention to the fact that spontaneous fragmentation of stone may occur. leading to complete disintegration and expulsion of the fragments.

Prophylaxis.—The presence of gravel in the urine, or other evidence of supersaturation with solids, such, for instance, as heavy deposits, should lead to such hygienic and dietetic regulations as would naturally tend to lessen the specific gravity of the urine passed. Of prime importance is the careful regulation of the stomach, since when the functions of this organ are interfered with, even to a slight degree, the quantity of uric acid in the urine is markedly increased.

Systematic exercise should be prescribed, and the bowels kept fairly soluble, preferably by salines administered in the morning on rising and at night just before retiring. This latter time is particularly one of choice in the case of an alkaline mineral water, because the urine naturally becomes most acid during the small hours of the morning. The liver should be occasionally stimulated to full activity by small doses of calomel frequently repeated, or by a blue pill. Supersaturation of the urine is avoided by diluting it with water or bland liquids. These must not be taken in sufficient quantity to cause indigestion. Since salt renders uric acid more soluble, it is well to use this liberally with food.

When there is gravel-formation, or quick deposit of uric acid after passing water, direct solvents should be employed intermittently. Of these salicylic acid or potassium salts are among the most useful. Piperazin is also of service in preventing stone, since it has the power of dissolving uric acid, and also of making oxidation more complete. It is best given in large quantities of water; fifteen grains may be dissolved in a pint, this whole portion being taken in divided doses during the day. It should not be administered in pill form. It has been stated that this drug will not only prevent formation of uric acid stones, but will even dissolve those already formed, and also the colloid matter which is always found as the medium in which the formation of the calculus takes place. Clinical evidence of such action is wanting.

Alkaline urine will also slowly dissolve pure uric acid: hence when for any reason operation is inadvisable, it would seem worth while to render the urine alkaline by the administration of full doses of potassium citrate, this drug being eliminated as the carbonate. When the urine shows excess of phosphates, a tonic treatment, together with the use of nitrohydrochloric acid, is indicated.

The formation of stone can sometimes be prevented by careful attention to the bladder. Remedies designed to render the urine bland and unirritating act locally, since they lessen the bladder-irritation, and thereby the secretion of albuminoid or colloid material, without which calculi will not form. When there is obstruction to the free evacuation of the urine, regular drainage of the bladder by means of a catheter is serviceable; and when there is cystitis, the administration by the mouth of substances which are antiseptic when eliminated by the urine, and direct irrigation of the bladder, should be practised. The antiseptic drugs administered by the mouth have already been considered, as have also the local washings appropriate in cystitis.

Treatment.—Stone having once formed and having been detected by direct examination, it remains to advise treatment. At one time attempts at removing calculi by the injection of solvent lotions into the bladder, or by the administration of medicines which when eliminated with the urine were supposed to dissolve the calculi, were popular. These methods are, however, so utterly wanting in evidence as to their efficiency that they are not worth considering.

The two received methods of treatment are (1) litholapaxy,—crushing and evacuating; (2) cystotomy,—removing the stone through either a perineal or a suprapubic incision. Litholapaxy is in both adults and children the method of choice.

Preliminary Preparation.—Whether the operation be crushing or cutting, the preliminary preparation of the patient is about the same. Except in old feeble prostatics, rest in bed is desirable for two or three days. This has a markedly beneficial effect upon the cystitis, since the calculus is kept quiet and does not mechanically irritate the bladder. The bowels should be regularly opened by salines and enemata, and the urine rendered bland by milk diet and diluents, and slightly antiseptic by salol and boric acid. Hæmaturia will usually cease promptly as the result of rest. Cystitis should be modified by irrigations or instillations. When the circulation is feeble, tonics and strychnine are indicated.

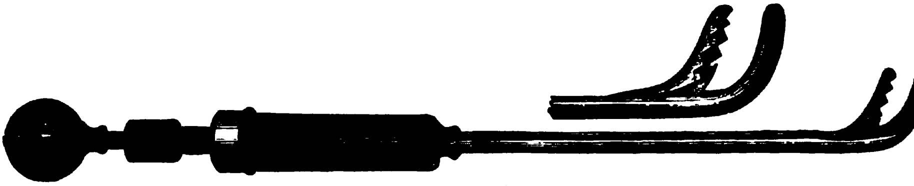
On the night preceding operation the patient should be given a laxative and a general hot bath, and should have the pubes and perineum shaved, and the whole operative area, including the penis and glans, treated as is customary in preparation for formal operations,—*i.e.*, cleansed with antiseptics and covered in by an antiseptic gauze dressing.

An enema should be given not less than four hours before operation. Immediately before operation the dressing is removed, and the whole region again cleansed by green soap, benzin, alcohol, and bichloride. This preparation applies to litholapaxy because that operation may have to be supplemented by lithotomy,—from jamming or breaking of the lithotrite, for instance, or because of an unexpectedly large stone.

LITHOLAPAXY.

To perform the operation an instrument for crushing the stone and one for evacuating the fragments after crushing are needed. The operation in its entirety was first practised by Bigelow in 1878, and has since then largely supplanted all cutting operations.

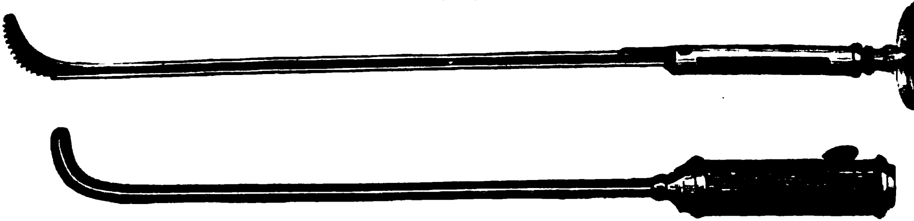
FIG. 138.



Bigelow's lithotrite.

The crushing instrument, or lithotrite, devised and since perfected by Bigelow (Fig. 138), is the one commonly employed, and perhaps is more satisfactory than any of the many modifications since suggested. (Fig. 139.)

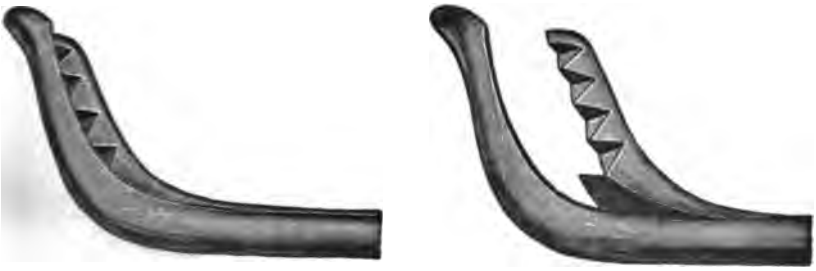
FIG. 139.



Weiss's lithotrite.

The instrument as now made contains a male and a female blade, so arranged that they can be separated or approximated by a sliding motion. As soon as the calculus is grasped the blades are locked by a turn of the collar of the handle; this turn at the same time brings a powerful screw in proper relation with a set of threads, so that on turning the knob of the extremity of the handle the male blade is forced downward and thus crushes the stone. Especial attention is devoted to the construction of the jaws and teeth; these are so made that clogging by the lodgement of masses of crushed calculi is impossible. Instruments made with wide fenestræ passing completely through the female blade are liable to have fragments jam so firmly that to remove the instrument without laceration of the urethra suprapubic cystotomy may be required. The male blade—*i.e.*, the sliding one—has blunt, pyramidal projections on the jaw, so that the cusps alone catch the calculus. As the latter is broken the fragments are shed to the sides, instead of being jammed against the female blade. The latter is fenestrated only at its base, to receive a spur on the base of the male blade, thus preventing the clogging of its heel by small fragments. (Fig. 140.) The tip of the female blade is slightly prolonged and curved back, thus allowing it to slide readily into the urethra, and also lessening the danger of penetrating the vesical mucosa as the blades are brought together.

FIG. 140.

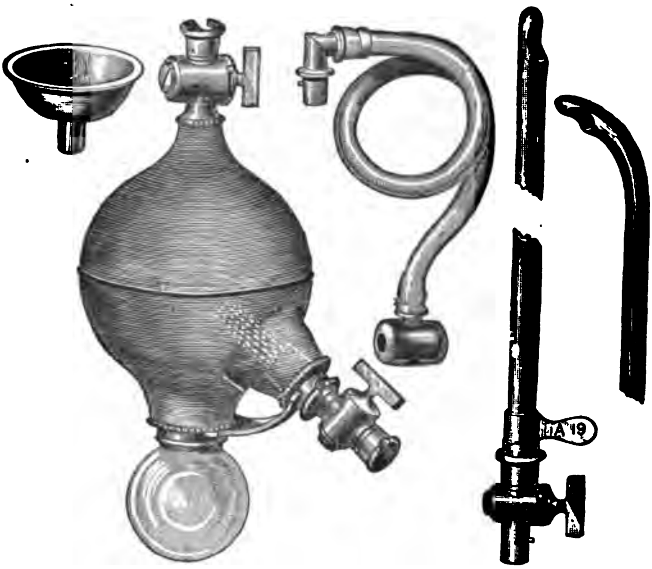


Jaws of Bigelow's lithotrite.

The advantages of this instrument are that it is powerful, does not jam, is simple in construction, and enables the operator to search for the calculus, grasp it, and crush it without taking his hands from the handle and without having to pause to separate the blades again by unscrewing.

The evacuating instruments required in the operation of litholapaxy are full-sized catheters of varying sizes, straight, or with a very slight curve at the end, provided with eyes fully as large as the calibre of the tube, and an aspirating apparatus, which consists of a thick rubber bulb with a wide-mouthed glass receiver attached below and an opening and stopcock above, so that it can be completely filled with water. (Fig. 141.) It has a double stopcock on the side, the latter fitting to the catheters externally, and internally connecting with a fenestrated tube, which penetrates one or more inches into the bulb. The aggregate emptying power of these fenestræ is greater than the open end of the tube, so that in forcing water into the bladder it rushes in through these small lateral holes with greater velocity than through the large opening at the end. Thus there is little danger that fragments will be drawn up into this tube from the receiver and driven back against the walls of the bladder.

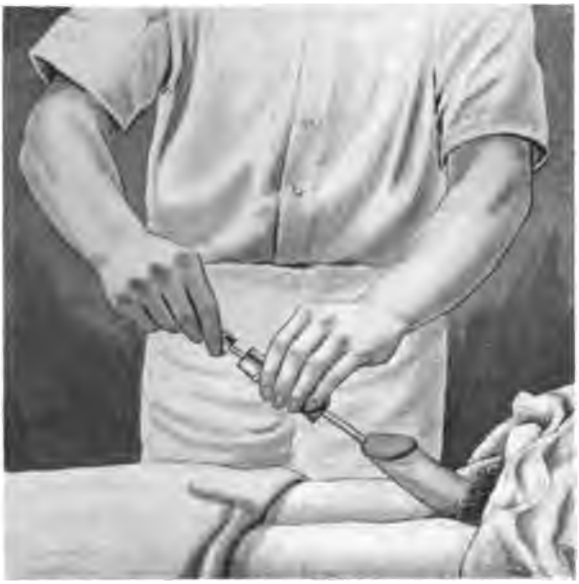
FIG. 141.



Bigelow's evacuator and tubes, with metal cup and soft rubber tube for filling.

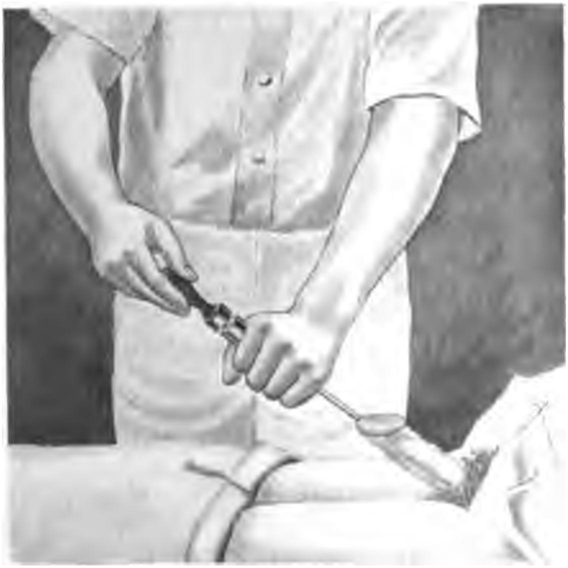
OPERATION.—The anæsthesia should be profound so as to render the bladder-wall passive and prevent reflex movements when the instrument is inserted. The urine is drawn, and the bladder is irrigated with an antiseptic, either silver 1 to 5000 or a sterile saturated solution of boric acid; six ounces of boric acid solution are then injected, preferably through the evacuator which the surgeon intends to use, as it is then certain that the urethral calibre will admit it. The patient is placed upon his back, the shoulders are raised, and the thighs well separated and slightly flexed. The lithotrite is introduced exactly as a sound is passed, the surgeon standing at the patient's left; spasm of the compressor urethræ muscle is overcome by the weight of the instrument. It must be remembered that the weight of the lithotrite and its long shaft place a powerful lever in the hands of the surgeon, which, if used improperly, may cause urethral rupture. When the beak

FIG. 142.



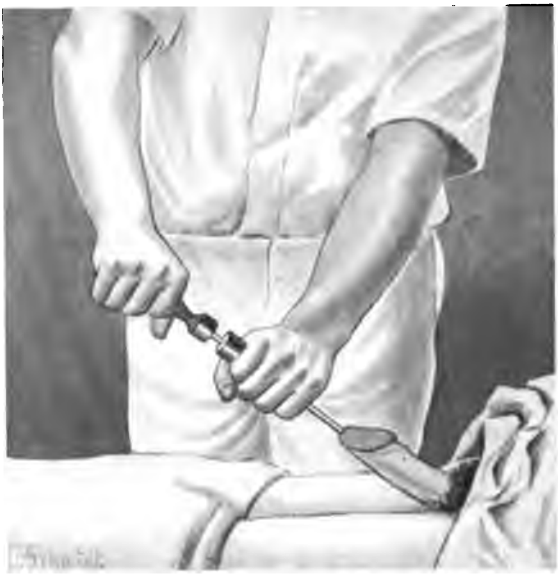
Opening and closing the blades of the instrument while searching for and grasping the calculus.

FIG. 143.



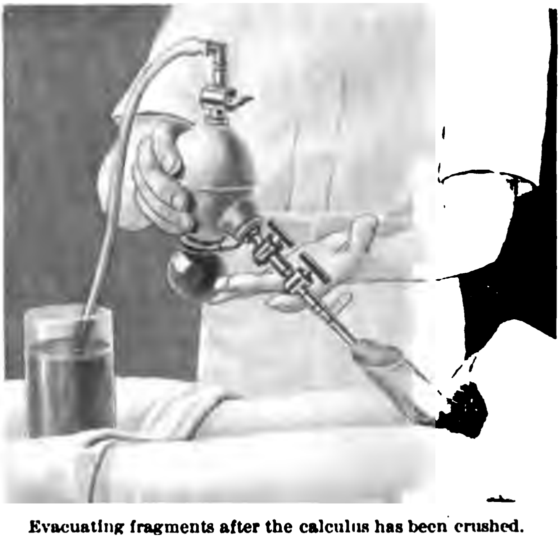
Crushing a small, soft calculus.

FIG. 144.



Crushing a large, hard stone.

FIG. 145.



Evacuating fragments after the calculus has been crushed.

of the instrument enters the bladder, the handle will lie between the thighs. The surgeon then passes to the patient's right. The beak should be gently pushed onward until it touches the posterior wall of the bladder, when the blades are separated until the male blade touches the neck of the bladder; they are then closed rapidly. If the calculus is caught, it should be fixed by a turn of the collar and then crushed by turning the screw-handle. If the calculus is not caught in the first manœuvre, the beak of the instrument should be gently turned from one side to the other, alternately opening and closing the jaws. If it still eludes the grasp, the lithotrite should be turned with the beak directly downward, thus exploring the region behind the prostate.

Whenever the calculus is grasped it should be firmly fixed by a half-turn of the handle, and the instrument should then be turned so that its beak points upward, and be withdrawn so that the stone will be, as nearly as can be guessed, in the centre of the bladder. By this manipulation the operator can assure himself that he has not grasped a portion of the mucous membrane, and can proceed to crush the stone by rapidly screwing down the handle. These manœuvres are repeated until the stone is reduced to small fragments. Were the operation to terminate here, as was at one time advised, it would be lithotrity, the older method being to allow patients to evacuate by natural efforts the fragments of stone thus crushed. This is, however, highly undesirable, for obvious reasons.

The tightly closed lithotrite having been withdrawn, an evacuating catheter of as large a size as can be introduced through the urethra is passed. The extremity of this instrument being kept well against the urethral roof, when it reaches the membranous portion of this canal its outer extremity is carried downward, pressure being exerted at the same time at the root of the penis by the index and middle finger of the left hand placed on either side of this organ, thus relaxing the suspensory ligament and straightening out the urethra. This manœuvre is especially useful when, as in this instance, it is necessary to pass an instrument the curve of which is less than the fixed curve of the urethra.

The evacuating bulb, filled with warm boric acid solution or sterile water, is then connected with the catheter, the stopcocks between the two are turned on, the bubbles of air contained in the catheter are allowed to rise to the top of the bulb and are squeezed out, the stopcock there being turned on for a moment, and then, by gentle slow pressure, about half the fluid in the bulb is allowed to pass through the catheter into the bladder. After waiting a few seconds for the fragments to settle about the base of the bladder, the pressure on the rubber bulb is suddenly relaxed, and thus the fragments are sucked up into the glass receiver. This process of alternately distending the bladder and sucking out the fluid is continued, the catheter being carried in different directions, until no more fragments escape. This may be determined by auscultation over the bladder during the process of aspiration, any fragments which remain being heard to click against the evacuating catheter. The catheter should then be withdrawn, the stone-searcher introduced, and careful search made for any remaining calculus; none being found, the operation is completed.

In place of the aspirating instrument used by Bigelow, it is worthy of note that if the fragment is thoroughly pulverized the natural expulsive force of the bladder is sufficient entirely to evacuate the fragments. This may be accomplished by introducing a full-sized catheter, distending the bladder by a gravity-bag or syringe, then allowing the contents to flow away in a full-sized stream. It is obvious, however, that this method of evacuation is not so sure as that provided by the Bigelow apparatus.

The only serious complication liable to occur during the course of litholapaxy is the clogging of the blades. This should be obviated by rapping them sharply and quickly together several times. If this manœuvre fails, the tip of the instrument should be brought up against the pubis and suprapubic cystotomy performed. In case the bladder should be ruptured, immediate suprapubic cystotomy and drainage would be indicated.

The further treatment is so directed that the patient is kept quiet in bed on a milk diet for five to seven days, or until pus and blood disappear from the urine. During this time salol is given by the mouth and the bowels are kept open by enemata. For the first twenty-four hours after operation the whole abdomen should be covered with hot antiseptic compresses, changed every two hours.

Guyon warmly commends the retained catheter as an after-treatment of litholapaxy, keeping it in place for twenty-four hours. Many of his cases had been infected for a long time, and were old prostatics with phosphatic calculi, the class in whom vesical operation is likely to result fatally. His results were most favorable, and seemed to indicate that the retained catheter distinctly lessens mortality in infected prostatics with vesical calculi.

Chismore describes a modification of the Bigelow operation employed by him in fifty-two cases. His patients were all old, and many of them were prostatics. He had no deaths. He believes that his method is particularly applicable to cases of senile atrophy with pouched or irregular bladder. These conditions, together with the consequent alterations of the vesical orifice of the urethra, make it impossible to command considerable portions of the cavity of the bladder with the lithotrite, or indeed with any instrument introduced into the urethra or through a perineal incision, besides favoring the escape and retention of fragments of calculi during litholapaxy.

Chismore substitutes local for general anæsthesia, and conducts his crushings in a series of short office-sittings. He empties the bladder, injects one or two fluidounces of a four per cent. solution of cocaine hydrochlorate, gently inserts the lithotrite, and seizes and crushes the stone. If a large fragment apparently disappears, he makes no prolonged attempt to find it at that sitting. He crushes as long as fragments are readily found, washes out the pieces, and stops the moment spasm of the bladder, unusual distress, or symptoms of exhaustion occur. He does not hesitate to leave some pieces after crushing, but removes them after the reaction due to operation has subsided, and as soon as they can be felt with a searcher, usually within a week. He repeats his partial operations and evacuations until the bladder is clear. As these patients usually have strictures, or at least a narrowed urethra, a period of preliminary dilatation is often necessary.

The male blade of his lithotrite is hollow, and is attached to an evacuator of simple and ingenious construction. As the stone is crushed it is evacuated through the male blade. This avoids repeated passing of instruments, and is also a valuable means of drawing into the grip of the lithotrite calculi which otherwise could not be reached; for when the instrument is opened, if the bulb of the evacuator is compressed and then suddenly released, fine fragments will be drawn through the canula of the male blade and into the receptacle placed externally, while fragments too large to pass will be sucked exactly into the grip of the instrument. When no more pieces of stone are readily found, Chismore washes out the bladder with warm boric acid solution. This operation is conducted in his office, the patient paying visits as often as is required. Following operation there is usually an immediate sense of relief; the reaction is slight. The patient's sensations will prove a valuable guide as to the presence or absence of further fragments. When frequency, tenesmus, purulent urine, and a sensation of stone occur, the searcher is used, the presence of a stone determined, and the operation repeated.

Perineal Litholapaxy.—This operation, which was originally described by Keith in 1892, has not met with the success which its advantages should justify. Many authors indicate the performance of the perineal operation under some or all of the following conditions: (1) A large stone necessitating the use of a lithotrite which will not pass easily by the natural route. (2) A very hard stone necessitating the passage of a similar instrument. (3) Stricture in conjunction with a large or hard stone or perhaps of any stone. (4) A difficult or narrow urethra. (5) Imperfect equipment. (6) Cases in which litholapaxy has been commenced in the ordinary way, but cannot be completed satisfactorily owing to swelling of the urethra and deposit of débris. The operation differs somewhat from that of lithotomy. A curved staff with a median groove is introduced into the bladder. The scrotum is allowed to assume its natural position. A very small incision is now made with the point of a tenotomy knife, in children about one inch in front of the anus through the median raphe, and the urethra incised for one-eighth of an inch. The point of an ordinary director is inserted through the wound and passed into the bladder through the prostatic urethra, which is then dilated up to the required size. The evacuating catheter is now passed, the bladder injected, and the lithotrite follows without difficulty. The operation is completed in the same way as in ordinary litholapaxy, and, as a rule, there is no difficulty in retaining fluid in the bladder. In order to avoid a valvular aperture, it is most important that the skin should not be displaced while making the incision. This method is not intended to replace lithotomy, which will remain the operation of choice when cutting must be done.

Reginald Harrison is perhaps the strongest advocate of this procedure. He thus sums up the chief points in favor of perineal litholapaxy: "(1) It enables the operator to crush and evacuate large stones in a short space of time. (2) It is attended with a very small risk to life as compared with other operations where any cutting is done, such as lateral or suprapubic lithotomy, and is well adapted to old and feeble subjects. Swinford Edwards has shown that the latter operation for large stones has a mortality somewhat about fifty per cent. (3) It permits the operator to wash out the bladder and any pouches connected with it more effectually than by the urethra, as the route is shorter and the evacuating catheters employed of much larger calibre. (4) The surgeon can usually ascertain, either by exploration with the finger or by the introduction of forceps into the bladder, that the viscus is cleared of all débris. (5) It enables the surgeon to deal with certain forms of prostatic outgrowth and obstruction complicated with atony of the bladder in such a way as to secure not only the removal of the stone but the restoration of the function of micturition. (6) By the subsequent introduction and temporary retention of a soft rubber drainage-tube states of cystitis due to the retention of urine in pouches and depressions in the bladder-wall are either entirely cured or are permanently improved. To lock up unhealthy ammoniacal urine in a bladder that cannot properly empty itself after a lithotrity is to court the formation or recurrence of a phosphatic stone. Hence it is well suited to some cases of recurrent calculus.

"It is well adapted for some cases of stone in the bladder complicated with stricture in the deep urethra, as it enables the surgeon to deal with both at the same time. Nor does it expose the patient to the risk which may be attendant where lithotrity is performed with a weakened or permanently damaged urethra."

Harrison demonstrated that crushing forceps shaped somewhat like the blades of a lithotrite, and not exceeding in circumference that of the ordinary index finger, are sufficiently powerful to pulverize any stone that can be thoroughly seized. The fragments may be subsequently withdrawn by means of evacuating catheters passed through the wound, or even by forceps. If care is taken to make the perineal opening of a size corresponding to that of the evacuating catheters, which should be as large as an ordinary index finger, the bladder is readily kept distended during the necessary manipulations.

The opening is made into the membranous urethra at the apex of the prostate on a grooved staff passed along the urethra. Through this opening is first passed the Wheelhouse tapering gorget, and guided by this instrument the index finger is introduced into the bladder.

Litholapaxy in Children (infancy to puberty).—There has long been a popular belief that in children lithotomy is a safer operation than litholapaxy. Recent statistics have established beyond cavil the greater safety of the latter operation.

Of 1213 cases performed by eleven operators the mortality was 2.22 per cent.; perineal lithotomy gives a mortality twice as great as this; suprapubic lithotomy one more than five times as great. The combined statistics of Cabot and Barling are still more favorable to the crushing operation: perineal lithotomy, 602 cases, 19 deaths,—a percentage of 3.1; suprapubic lithotomy, 637 cases, 84 deaths,—a mortality of 13.1 per cent.; litholapaxy, 284 cases, 5 deaths,—a mortality of 1.7 per cent.

No age is exempt from calculus, since it has been found in the fœtal bladder. About half of all cases of vesical stone are observed in children: hence in them operation for its removal is frequently required. Keegan states that the urethra of a child from three to six years of age will usually accommodate a No. 6 to No. 8 English lithotrite, while a No. 12 to No. 14 can be passed into the urethra of a child of eight to ten years.

Otis has shown that in children as in adults the small diameter of the urethra may be greatly increased with entire safety. He states that the proportionate relation between the circumference of the urethra and that of the penis which he believes to exist in adults holds good in children. Thus, with a penile circumference of one and a half inches, as in a child from two to three years of age, the size of the urethra would not be less than fifteen millimetres. For every quarter of an inch added to the penile circumference two millimetres may be added to the urethral calibre. It should be remembered that this indicates rather the distensibility than the actual calibre of the canal.

Recurrence of stone may be observed after any operation. Keegan states that after an extended experience he is convinced that this recurrence in male children does not follow litholapaxy oftener than it follows lithotomy.

There are certain objections to the operation of lithotomy which, even were its mortality as low as that of litholapaxy, should have due weight in deciding for one operation or the other. Thus, the space in which manipulations must be conducted is extremely small, often preventing the introduction of a finger along the staff. Of course this can be obviated by making no digital exploration of the bladder, the small forceps being passed in directly and the stone thus removed; but in this case the surgeon cannot be sure that the bladder is entirely empty. The high position of the bladder in children, the delicacy and mobility of the deep urethra, the danger of wounding the bulb in making an incision which is sufficiently large, and the possibility of the operation being followed by sterility are all factors which should be considered in cutting for stone in children.

Cabot says that his experience has proved that the urethra and bladder of children are extremely tolerant of instrumentation: hence he advises litholapaxy for small stones or those of moderate size (from three-fifths to four-fifths of an inch in diameter), and for larger stones perineal lithotomy, unless they are of unusual size (from one to one and a half inches in diameter), when suprapubic cystotomy is indicated. It is fairly easy to determine the approximate size of calculi in children by bimanual palpation. Guided by this, the appropriate method is selected.

After due consideration of the opinions of others and an extended personal experience, we believe the following conclusions to be justifiable.

In every case of calculus in male children litholapaxy, on account of ease of performance, low mortality, speedy recovery, and absence of danger of emasculation, should be the operation of predilection, division of the meatus being freely resorted to if that portion of the urethra offers an obstacle to the introduction of instruments.

The lithotrite and evacuating-tube should be of such size that they can be inserted into the bladder without much effort or over-distention, and great gentleness should be observed in passing these instruments. Keegan says, "When I advocate litholapaxy as being the best operation, in my opinion, for the great majority of stones occurring in male children and boys, I do so with a very important reservation,—viz., that no one should attempt to perform it in boys until he has first gained some practical experience of it in adult males. The surgeon who meets with cases of stone only at rare intervals during his career will be acting more wisely if he adheres to lateral lithotomy or suprapubic cystotomy. It is his misfortune and not his fault that he has not been afforded many opportunities of gaining a practical familiarity with the use of the lithotrite. Should he aspire to performing this operation widely and successfully in male children and boys, he must provide himself with a large assortment of fully fenestrated lithotrites of small size, made from the best steel which money can purchase, by thoroughly reliable workmen. His set of lithotrites, all fully fenestrated, should range from No. 4 or 5 at the bend of the blades to No. 10 at the end of the blades (English scale), and his evacuating catheters or canulæ should be fitted with serviceable stylets."

The instrument should be withdrawn and reintroduced as seldom as possible. If, however, a lithotrite which fits the urethra tightly has been used, it is well to change this for one of smaller size before pulverization of the fragments, since the entrance of the calculus sand into the urethra, by making the shaft of the instrument rough and by becoming deposited on the mucous membrane, may render the withdrawal of the full-sized instrument exceedingly difficult. In seeking for or attempting to seize the stone, care should be taken to avoid such wide separation of the blades as will bring the male blade in frequent contact with the vesical neck. The crushing should invariably be done only after rotating the blades into the centre of the bladder. Every particle of the calculus should be evacuated. Copious irrigation of the anterior urethra through a soft catheter carried to the compressor urethræ muscle aids in freeing it from fine solid particles which may be lodged on its surface.

Rest in bed, milk diet, and sterilization of the urine by boric acid or salol given internally, both before and after the operation, are valuable adjuvants. During the operation every antiseptic precaution should be observed. Southam very properly emphasizes the importance (*a*) of this preliminary sterilization of the urine by the administration of salol and boric acid, and if need be by irrigation of the bladder, and (*b*) of the avoidance of shock by thorough protection of the patient against surface chilling.

The exceptional cases of calculi which are both large and hard may be best treated by suprapubic lithotomy, but neither unusual size nor a moderate degree of density should of itself be thought positively to contra-indicate litholapaxy.

Perineal lithotomy has now a very limited field, and should be employed chiefly in those cases in which the stone is thought to be of small or medium size, and in which no lithotrite, however small, can be introduced with safety.

CONTRA-INDICATIONS TO LITHOLAPAXY are—1. Tight fibrous stricture of the deep urethra. This contra-indication is not absolute, since the stricture may be divided by external incision and the stone then crushed and evacuated. Median perineal litholapaxy or lithotomy is to be preferred. 2. Severe chronic cystitis, for the cure of which permanent drainage, supplemented by irrigations, is indicated. 3. Organic visceral lesions which make the prolonged administration of an anæsthetic especially dangerous, as hæmoptysis, atheroma, or a history of apoplectic attacks. Under such circumstances Chismore's operation or lithotomy is indicated. 4. A nucleus that cannot be comminuted or removed through the evacuating-tubes, as a pipestem or a lamp-wick. 5. Sacculation or encysting of the stone. Even though the calculus can be reached by the lithotrite, attempts to seize and crush it are dangerous, since the vesical walls surrounding it are thin and extremely vulnerable. The suprapubic operation is indicated in these cases. 6. Large size and unusual hardness. (Figs. 152, 153.) A very few stones come in this category. Small hard stones should be taken out by perineal lithotomy. Exceptional hardness, combined with great size, is the only clear indication for suprapubic lithotomy in adults before middle age, except the presence of stone in diverticula, or its association with tumor or other conditions requiring for their treatment the suprapubic incision.

The most recent statistics of operation performed upon calculus patients ranging from puberty to middle age are as follows: perineal lithotomy, 226 cases, 22 deaths, 9.7 per cent.; suprapubic lithotomy, 159 cases, 18 deaths, 11.3 per cent.; litholapaxy, 485 cases, 22 deaths, 4.5 per cent. It is clear from these figures that litholopaxy is the operation of choice. Exceptionally it may be undesirable or impossible.

The superior value of litholapaxy in old age, as shown by statistical evidence, is even more striking than in childhood or middle age. This is as follows: perineal lithotomy, 69 cases, 13 deaths, 19 per cent.; suprapubic lithotomy, 91 cases, 17 deaths, 18 per cent.; litholapaxy, 581 cases, 40 deaths, 7 per cent. In old age the special contra-indications to litholapaxy, in addition to those mentioned as applying from puberty to middle age, are—(1) Enlargement of the prostate so pronounced that the lithotrite either cannot be introduced, or if successfully passed cannot reach the stone, even though an effort be made to lift this from the post-prostatic pouch by a finger in the rectum. (2) Atony of the bladder.

Complications of Litholapaxy.—It may happen that the surgeon, having taken it for granted, because of the history of the patient, that the urethra will receive his instruments, finds some obstruction which prevents them from passing. Usually this is because of a narrow meatus. In that case it is at once obviated by meatotomy. It may be from an anterior stricture. This should be treated by internal urethrotomy, the patient then wearing a continuous catheter for a few days after litholapaxy. If the stricture is deep and dense, this indicates median perineal lithotomy or litholapaxy together with urethrotomy. If the obstruction is in the prostate and cannot be overcome without the use of force, the crushing operation must be abandoned.

It may happen that though the urethra receives the lithotrite, the smallest evacuating-tube which the surgeon has fails to pass. If the stone is crushed before this is discovered, it constitutes an embarrassing complication, since, even after the finest practicable fragmentation, it is comparatively unsafe to allow the fragments to be passed through the urethra. It is with the idea of avoiding this complication that we have advised injection of the bladder through the evacuating-tube which the surgeon intends to use. He will then discover before having crushed the stone that the tube cannot be passed, and can either procure a smaller tube or at once proceed to remove the stone by the appropriate cutting operation.

If the stone has been crushed and no evacuator can be introduced, but a staff can be passed, lateral lithotomy should be performed and the fragments removed by the scoop and irrigator.

The lithotrite may jam with the blades so widely open that their withdrawal when in this position would almost certainly entail laceration of the urethra. If a series of quick jarring closures fail to free the blades, they should be turned forward against the anterior surface of the bladder and be cut down upon above the pubis; or they may be reached and cleared by perineal incision. Bending of the blades may require similar operations. Should the blades break, the shaft should be removed, if possible, without the exertion of force; the fragments can then be taken out by a median perineal operation. It is to the credit of the instrument-makers that very few lithotrites have been bent or broken in crushing stones.

The bladder may be ruptured during preliminary injection or during attempts at evacuation of the stone fragments. Rupture during injection would be suggested were it found impossible to move the blades of the lithotrite freely in the bladder for want of room, thus showing it to be partly or completely empty. If this accident occurred during the use of the evacuator, unusually free bleeding would be noted, and the liquid injected would fail to return, the mucous membrane being constantly sucked into the eye of the evacuating-tube, in whatever position this might be placed.

As sequelæ of litholapaxy there may develop—(1) Shock or collapse, resulting fatally in a few hours. (2) Hemorrhage. (3) Suppression of urine, which may be fatal in one or two days. This is observed in old persons with crippled kidneys, in whom the slightest interference is liable so to disturb equilibrium that the kidneys become insufficient. (4) Urinary fever. This may be transitory, passing off in from twenty-four to forty-eight hours, or may develop into a true septicæmia. (5) Ascending pyelonephritis, with the development of surgical kidney. (6) Prostatitis and epididymitis. (7) Pelvic cellulitis extending from a pericystitis. (8) Phlebitis involving primarily the prostatic plexus, sometimes extending to the whole pelvic venous system, and causing extensive thrombosis with œdema of the legs, or septic embolism and death from pyæmia. (9) Peritonitis. This may be caused by extension of inflammation due to trauma inflicted on the bladder-wall. With the exception of uræmia of the aged, these complications are rare if proper care is taken, and can be readily avoided.

LITHOTOMY.

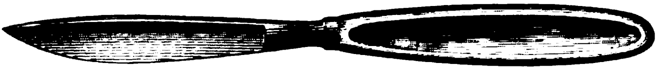
Lithotomy, as this word is used in surgery, indicates an incision into the bladder for the removal of stone. The bladder may be opened through the perineum by lateral, bilateral, median, or medio-bilateral incisions. It may be opened through the abdominal walls by a suprapubic incision.

Perineal Lithotomy.—In many of the cases not suited to the operation of litholapaxy the stone may be removed through an incision which involves the perineum and the neck of the bladder. Some few surgeons still hold that this operation is the one of choice in young children, basing this opinion upon its low mortality. Though the mortality is undoubtedly low in children, that of litholapaxy is still lower, as has been abundantly proved by modern statistics.

In all forms of perineal lithotomy the following anatomical landmarks should be considered. The perineum is triangular in form, having its apex at the symphysis pubis, and for its boundaries the rami of the ischia and pubis laterally, and an imaginary line passing through the centre of the anus and connecting the tuberosities of the ischia. The perineal centre is a point midway between the centre of the anus and the perineo-scrotal junction; it marks the middle of the lower edge of the triangular ligament. Just in front of this point are the bulb of the penis and its arteries. The raphe extends in the mid-perineal line from the anterior edge of the anus up over the scrotum. Beneath it there are no arteries of importance.

The depth of tissue between the skin and the bladder in the male adult varies from two and a half to three inches when measured near the base line of the perineum, and about an inch in the anterior portion.

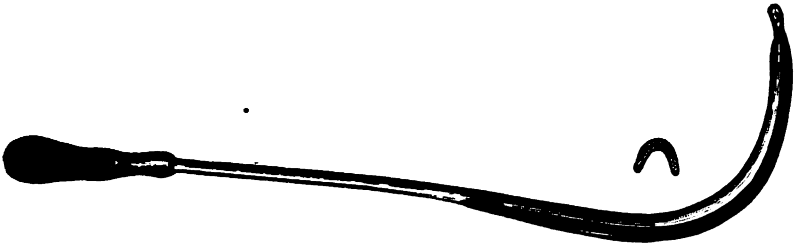
FIG. 146.



Lithotomy knife.

LATERAL LITHOTOMY.—The following instruments are needed for the lateral operation: a lithotomy knife; this is a scalpel with a three-inch blade and a moderately heavy handle (Fig. 146); a probe-pointed bistoury, for enlarging the prostatic incision, should this be

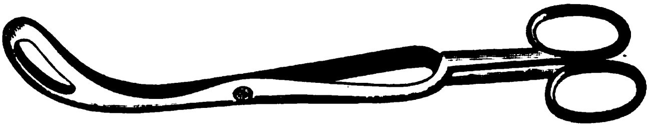
FIG. 147.



Grooved lithotomy staff.

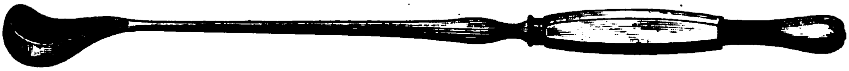
necessary; a large curved lithotomy staff (Fig. 147), grooved on the under surface or on the side; the lateral groove is preferable, because it is more easily felt by the finger in the wound; the groove should be deep enough to prevent the knife from slipping out when once engaged; straight and curved lithotomy forceps (Fig. 148), the straight answering for most purposes except when the calculus is lodged in a pouch posterior to the prostate, when the curved forceps will be required; a scoop (Fig. 149) for dislodging the calculus from a sacculation, for removing débris, etc.; a catheter *en chemise*, or a Buckston-Browne air-tampon, for controlling hemorrhage, should it be excessive.

FIG. 148.



Stone forceps (curved).

FIG. 149.



Calculus scoop.

The catheter *en chemise* is made by passing a gum catheter through the centre of a piece of gauze or muslin four inches square; the muslin is slipped along the catheter till it is about one inch from its eye; it is then firmly wrapped with silk about the point of puncture, thus securing it in place and allowing the muslin or gauze to hang free as would a petticoat. When needed to stop bleeding, this catheter is passed into the bladder through the wound, and the space intervening between the muslin and the catheter shaft is then packed with iodoform or other antiseptic gauze. Buckston-Browne's air-tampon acts as does the Barnes bag, being inflated after it has been put in position: the air-bag surrounds a catheter.

A lithotrite should be provided, in case the stone should be too large to be removed whole, and also the surgical instruments required in all cutting operations,—*i.e.*, hæmostatic forceps, tenacula, grooved director, and probe. Preliminary disinfection of the urethra and the operative region having been accomplished, and the rectum having been emptied, the patient, thoroughly anæsthetized, is placed on the table, and previous to operation the stone is again sought for. Unless it is found at this time, the operation should be postponed. If it is detected, the urine is drawn by a catheter, and from six to eight ounces of boric acid solution or other antiseptic are injected; the patient is then brought to the edge of the table with his thighs well separated and flexed on the abdomen and the legs flexed on the thighs, the position being maintained either by assistants or by mechanical contrivances. The buttocks should project slightly over the end of the table. The grooved staff is then passed into the urethra, and if possible the stone is again felt with it. Its tip being well within the bladder, the curve of the staff is pulled up against the symphysis; its shaft should be exactly in the middle line or inclined a little towards the right groin. The surgeon, having placed the staff as he wishes it, directs an assistant to hold it exactly in this position. The incision is made from a point an inch and a quarter in front of the anus and a little to the left of the raphe, downward and outward for three inches, to about the middle of the space between the anus and the tuberosity of the ischium, inclining slightly more towards the ischium to avoid injuring the rectum. The first incision is deeper anteriorly, and divides the skin, superficial fascia, transverse perineal muscle, a few posterior fibres of the accelerator urinæ, branches of the superficial perineal vessels and nerve, and the inferior edge of the superficial layer of the triangular ligament; at the posterior portion of the incision the inferior hemorrhoidal vessels and nerves are laid bare. All freely bleeding vessels are at once secured by hæmostatic forceps, which are not removed till the operation is completed. The space containing the membranous urethra bounded by the superficial and deep layers of the triangular ligament having been thus opened, the surgeon introduces his finger into the wound and feels for the groove of the staff. Finding it, and with his left forefinger as a guide, the point of the knife is passed into the groove, and, by either pushing the staff and knife backward together or following the groove with the point of the knife, the bladder is entered at its neck. To extract the calculus easily it is necessary to incise the left lobe of the prostate: this is accomplished by depressing the knife so that the greatest cutting pressure is brought to bear on the heel of the blade. The blade of the knife should be kept parallel with the external wound. This cut divides the deep layer of the triangular ligament, the anterior fibres of the levator ani, a portion of the compressor urethræ muscle, the left lobe of the prostate, the membranous and the prostatic urethra, and nicks the vesical neck. A deep incision into the neck of the bladder may cause serious hemorrhage from wounding of the prostatic plexus of veins, or, by opening the recto-vesical fascia, may allow of urinary infiltration. If the staff is kept well up against the pubis and the blade of the knife is not permitted to leave its groove, the incision into the prostate and the neck of the bladder is not likely to be too deep. The entrance of the knife into the bladder is marked by a rush of urine or of the fluid injected. The prostatic wound may be enlarged during the withdrawal of the knife, endangering the rectum. The better plan is to make the wound as free as is required, by depressing the handle during the passage of the knife inward, when its tip is engaged in the groove of the staff. Having thus opened the prostatic urethra and the vesical neck, the left forefinger of the operator, guided by the groove of the staff, is introduced into the bladder; when the stone is felt the staff is withdrawn.

The operator's finger being within the bladder, the closed forceps is introduced along this as a guide until the blades are well inside. It is then opened and rotated on its long axis to the right, thus enabling the right-hand blade to act as a scoop, which slides beneath the calculus. When the stone is firmly grasped in the forceps it is removed by traction made upward and forward in the line of the pelvic axis. A slight rocking motion often assists in its delivery. When the stone is oblong or irregular in shape it is important so to grasp it that its smallest dimensions shall be presented to the opening.

In children the use of a blunt gorget—*i.e.*, a broad, straight-bladed knife with a blunt probe-point which follows the groove of the staff—is of use, owing to the prostate being a rudimentary body and the vesical neck not being of sufficient size to allow of the introduction of the finger. The forceps, guarded by the flat surface of the gorget, are introduced, with somewhat more of an inclination towards the symphysis than in the adult, owing to the relatively high position of the bladder in children.

Failure to find the calculus at the first trial may be due to its lodgement behind the prostate. Repeating the attempt and meeting with no success, the curved forceps should be substituted and introduced with the points downward and the handle slightly raised, when the calculus will usually be found. If the calculus cannot be removed, owing to the edges of the wound overlapping, the fingers may be used as retractors or a sufficient incision made with the probe-pointed knife, the incision being preferable to tearing the wound in the effort of extraction. The bladder should be explored with either the finger or a sound after the stone has been extracted, to be certain that no other stone remains. Every portion of its walls should be felt. This is accomplished by making suprapubic pressure while the examining finger is in the bladder.

Soft calculi, by breaking into several pieces from the pressure of the forceps, usually prolong the operation and necessitate the use of a scoop and careful irrigation in order that all the fragments may be removed. Sometimes, in spite of every precaution, a small fragment remains, forming a nidus for new concretions, thereby necessitating a second operation. Recurrence of stone, however, does not prove that operation was incomplete, this frequently taking place when it is absolutely certain that the bladder has been emptied.

Other complications may occur. Among them is excessive hemorrhage following the first incision, and due to wounding of the artery of the bulb, either from its anomalous position or because the incision is carried too far forward; or the distended hemorrhoidal vessels may be the source of the bleeding. Hemorrhage from such a source is easily controlled by means of hæmostatic forceps, replaced by ligatures at the termination of the operation if the bleeding continues.

Hemorrhage from the deeper incision is rarely profuse, and usually stops from the pressure of the fingers or of the instruments introduced. These proving insufficient, a catheter *en chemise*, or a Buckston-Browne tampon, may be inserted after the removal of the calculus; this usually controls it.

Through careless manipulation the staff may not enter the bladder, but may be caught in a pouch of the urethra. Should such an accident occur, the staff should be withdrawn and reintroduced until it is brought in contact with the stone.

It has happened in lithotomies performed on children that, owing to the small size of the incision in the vesical neck and the prostate, efforts at introducing the finger into the bladder have resulted in tearing the membranous urethra completely across and pushing the bladder up out of the pelvis. Such an accident demands suprapubic cystotomy, the passage of a catheter from the bladder out through the urethra, and the suturing of the torn ends of the urethra.

Wounding the rectum, due to insufficient lateralization of the knife, sometimes occurs; the wound usually heals spontaneously, though a fistula may follow. To guard against such a result, the rectal wound should be stitched as soon as discovered.

Peritonitis has resulted from opening the posterior wall of a contracted bladder: to obviate such an accident, the bladder should be moderately distended with fluid, and the knife should not be carried too far forward into the wound.

The perineum may be so deep that it will be impossible to introduce the finger into the bladder to guide the forceps to the stone.

Should such perineal depth be anticipated, some other operation should be chosen. When this condition is discovered after the incision has been made, a blunt gorget, with thin but not sharp edges, may be used to guide the forceps, the gorget being withdrawn as soon as the stone is grasped.

Formerly the gorget was considered an instrument of necessity in all lithotomies, as was a broad probe-pointed knife used in making the prostatic wound. At present it serves as a guide to the passage of other instruments into the bladder, its edges not being sharp. It is also used to enlarge the wound in the prostate, its point being engaged in the groove of the staff; in this case its edges should be sharp.

Prostatic enlargement may necessitate the use of the gorget instead of the finger as a guide. In these cases there may be such extreme rigidity of the neck of the bladder that full dilatation of the prostatic urethra will be required before instruments for the extraction of the stone can be passed. A pair of straight or curved Spencer-Wells forceps, opened out after introduction into the wound along the groove of the staff, is then serviceable. Forcible dilatation of the prostatic urethra has been followed by complete disappearance of the urinary symptoms.

It may be hard to complete the operation because of the size of the stone. A calculus over two inches in diameter could scarcely be removed through the perineal opening unless the incision were dangerously large or the tissues seriously bruised. Bimanual palpation should always detect a stone of this size, and should prevent the surgeon from making efforts at removal by perineal operation. In case previous examination has been neglected and the bladder is already open, the stone may be crushed and removed in fragments.

Sacculation may make the operation difficult. The stone may be freed from its fixed position by stretching the opening in the sac by means of the finger or by notching it in several places with a blunt-pointed knife. It is often impossible to remove a sacculated stone through a perineal opening: the high operation should then be performed.

After-Treatment of Perineal Lithotomy Cases.—The bladder, having been cleared of calculi and incrustations, should be well irrigated with hot sterile water (110° F.). This removes small fragments and clots and serves to control hemorrhage.

Should hemorrhage from the bladder-neck or the prostate persist, the air-tampon or the catheter *en chemise* is inserted. This may be removed within seventy-two hours.

When there is cystitis, particularly if this is of long standing, perineal drainage is indicated. This is best secured by a full-sized gum catheter (30 F.) the tip of which lies just within the vesical sphincter. A rubber tube conveys the urine to a vessel under the bed or at a lower level than the bladder, the free end of the tube being submerged in an antiseptic solution. A light gauze dressing and a T-bandage complete the toilet of the wound, drainage being continued until the urine is clear, usually from three to eight days. The catheter is changed every second day; the bladder is irrigated twice daily, and each time this is done the gauze dressing is changed.

Should there not have been cystitis, artificial drainage is unnecessary; if hemorrhage does not require packing of the wound, a pad of iodoform gauze is loosely applied to the perineum, care being taken that it does not prevent the free escape of the urine from the wound. This escape continues for several days, and then stops for a day or two, owing to inflammatory swelling, then is again noticed, but becomes less marked till it ceases on final closure of the deep wound.

The patient should lie on his back in bed, suitable absorbent material (pillows of oakum enclosed in one layer of gauze, and frequently changed) should be placed so that it will catch the urine, and his thighs and buttocks protected from irritation by the urine by alcohol baths followed by liberal applications of thick zinc ointment, boric ointment, or carbolated cosmoline.

Immediate suture of the perineal incision has been tried, but is attended with great risks, owing to the fact that the deeper portion of the wound, being more or less bruised by instruments, may slough, and in the absence of drainage cause cellulitis. If the wound is allowed to remain open and heal slowly, granulation proceeds from the bottom surfaceward.

The patient should remain in bed from four to twenty-eight days, according to the rapidity with which the wound closes. In children closure of the wound takes place rapidly.

MEDIAN LITHOTOMY.—In this operation the line of incision follows the raphe between the scrotum and the anus. The patient being in the same position as for lateral lithotomy, a staff grooved on its under surface is introduced and held with its shaft at right angles to the plane of the body, its curve hooked up under the symphysis pubis. The point of the knife—preferably a narrow straight bistoury—is inserted at the perineal centre just posterior to the bulb of the urethra, and pushed on until its point engages the groove of the staff at the membranous urethra, where an incision is made about an inch in length.

The surgeon introduces his left forefinger into the wound and carries it through the prostatic urethra into the bladder. The staff is withdrawn and the forceps introduced. Should the parts resist the introduction of the finger, the prostatic urethra should be dilated by means of Dolbeau's dilator. It is best to overcome the resistance of the parts with the finger, owing to the danger of laceration in using instruments. A grooved director may be introduced along the staff before its withdrawal, the finger following the director, thereby allowing more room. The incision divides the skin, the superficial fascia, the sphincter ani, the lower edge of the triangular ligament, the compressor urethræ, the membranous urethra, and the apex of the prostate. No vessels of any size are encountered.

The advantages claimed for this operation are that there is no risk of injury to the seminal vesicles or the ejaculatory ducts, and that, no arteries of any size being divided, the hemorrhage is slight. There is some risk, however, of wounding the bulb of the urethra, an accident the dangers of which are much exaggerated.

Dolbeau modified the median operation by introducing a lithotrite through the wound, crushing the stone, and washing out the fragments at one sitting. Owing to the development of litholapaxy, his operation has fallen into disuse.

Bilateral Lithotomy.—The incision is crescentic, the centre of the curve lying from one-half to three-quarters of an inch in front of the anus, and its arms extending on each side to a point midway between the anus and the tuber ischii. The incision is deepened till the membranous urethra is exposed. The urethra is opened in the groove of the staff, and Dupuytren's curved double lithotome caché is introduced along the staff into the bladder. This instrument has the curve of a sound, and is provided with two sharp blades, capable of divergence from the staff, so that after introduction into the bladder through the urethra they may be expanded. Upon the withdrawal of the opened instrument a wide incision is made in both lateral lobes of the prostate. When the lithotome touches the stone in the bladder it is turned with its curve downward, and the staff is withdrawn; the blades are then opened to the desired width, and the instrument is withdrawn, the lobes of the prostate being divided from within outward. As the instrument is withdrawn it should be kept exactly in the middle line, and its handle should be slightly depressed. The finger is then introduced into the bladder as a guide to the forceps, and the stone is extracted as by the lateral method.

The advantages claimed for bilateral lithotomy are the free entrance into the bladder and the lessened danger of wounding the larger blood-vessels.

Medio-bilateral Lithotomy.—Civiale's operation is a modification of the preceding. The first incision, made in the median line, is deepened until the membranous urethra is opened, care being taken not to wound the bulb.

A straight lithotome is then introduced, which upon its withdrawal divides both lobes of the prostate as in the bilateral method.

The bilateral and medio-bilateral operations are not practised to any great extent at present, partly because they give but little more room than the median and lateral operations, mainly because they require a special instrument.

Perineal lithotomy is indicated for the removal of small hard stones which cannot be crushed. The lateral operation is the one of choice. If there is a dense stricture of the membranous urethra, or if the stone is not more than half an inch in diameter, median lithotomy is indicated; should this not give sufficient room, the lateral lobes of the prostate may be nicked by a blunt-ended knife or the straight double-bladed lithotome.

The sequelæ of lithotomy are much the same as those of lithotrity; there is, of course, greater likelihood of troublesome hemorrhages from the prostatic plexus, and of infiltration and cellulitis of the pelvic cellular tissues, because of the incision carried through the prostate. Shock, collapse, urinary fever, thrombosis of the pelvic veins, septicæmia, pyæmia, and peritonitis have all been recorded as following perineal lithotomy.

As remote sequelæ, vesico-rectal or urethro-rectal fistulæ, vesical or urethral fistulæ, and sterility are possible. Though it would seem difficult to wound and obliterate both ejaculatory ducts in the operation of lateral lithotomy, there is sufficient clinical evidence that this sometimes occurs.

Suprapubic Lithotomy.—Pierre Franco in 1561 is credited as having been the first to extract a calculus through an opening above the pubis. He deemed the operation too dangerous to be repeated, and performed it only as a last resort. The first to perform it in this country—according to Agnew—was Professor Gibson, of the University of Pennsylvania. Unfortunately, the case died from peritonitis.

With the advent of methods by which the extraperitoneal anterior portion of the bladder was made accessible, the suprapubic operation has gained in favor, and is distinctly indicated for the extraction of stones which are encysted or are too hard and large for lithotrity. (Figs. 151–153.)

In preparing for operation the suprapubic and perineal regions, the penis, scrotum, and urethra should be thoroughly cleansed as for any formal surgical procedure. The rectum is emptied by an enema just before the operation.

The patient, having been anæsthetized, is placed flat upon his back, with the pelvis and shoulders slightly raised to relax the abdominal muscles. The operating-table should be so arranged that the patient can in a moment be placed in the Trendelenburg position, should this be required. The varying relations of the peritoneum to the parietes of the hypogastric region, in accordance with vesical distention, have been already noted. Distention of the bladder rolls back the loosely attached peritoneum and exposes considerable bladder-wall not covered by that membrane. Distending the rectum elevates the posterior portion of the bladder.

Distention of both bladder and rectum lifts the bladder up against the pubic walls anteriorly, and, since it cannot sink down into the perineum, it stretches up into the abdominal cavity. (Fig. 150.)

The device for increasing the peritoneo-pubic space by distention of both bladder and rectum is known as the "Garson-Petersen method," and by it this space is increased to its utmost extent.

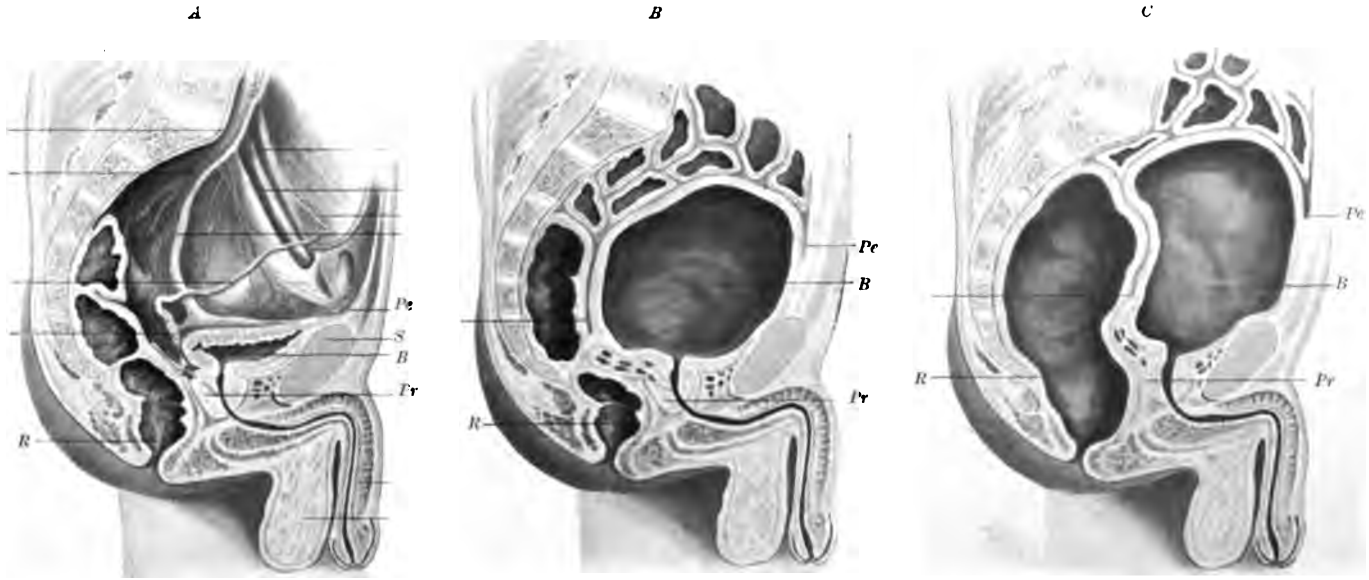
For the distention of the rectum a dilatable rubber bag,—"Petersen's rectal colpeurynter,"—collapsed and well oiled, is introduced into the rectum above the sphincters. The bladder is then emptied, and washed out with warm boric solution, and the rectal bag is dilated to the required extent; usually eight ounces of fluid are forced in. A quantity greater than this may cause laceration of the rectum. Following the dilatation of the rectum the bladder should be injected. From eight to ten ounces usually suffice for adults. The gauge of the amount to be injected is the pressure on the bulb of the syringe or the height to which the bladder rises above the pubis. Fluid should never be injected forcibly.

In children the amount injected should depend upon the age of the patient and the size of the lower bowel. Four ounces are enough. Owing to the fact that in early life the bladder is an abdominal rather than a pelvic organ, injections of this viscus and the Trendelenburg position will frequently accomplish the desired displacement, distention of the rectum being unnecessary.

There have been so many reported cases of rectal rupture following the use of the colpeurynter that most surgeons absolutely reject this appliance, holding that moderate injection of the bladder and elevation of the pelvis will give the desired room.

The bladder and the rectum having been distended, an incision is made from a little below the upper margin of the pubis upward in the median line of the abdomen for three inches. The cut is carried

FIG. 150.



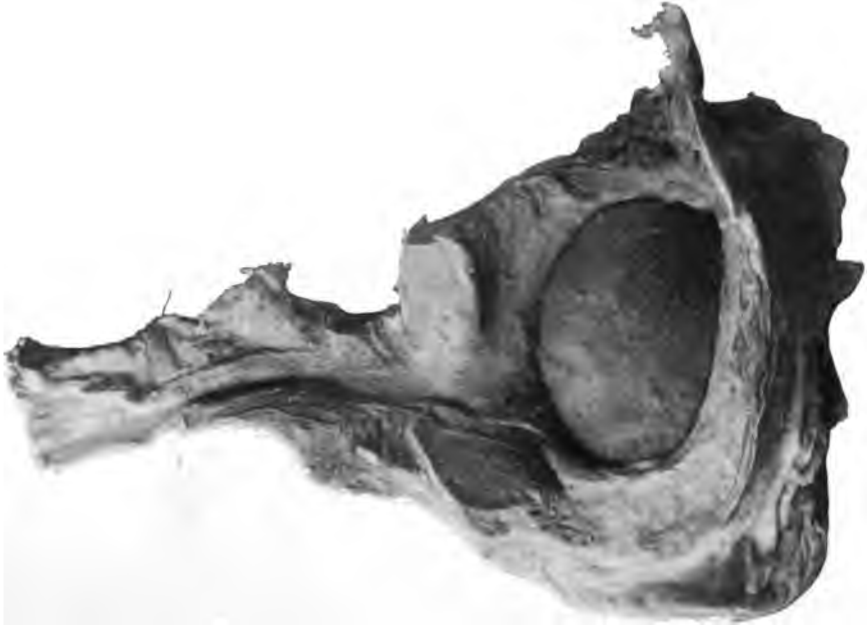
Normal relations.

Bladder distended.

Bladder and rectum distended.

Pe, Peritoneum; B, Bladder; R, Rectum; Pr, Prostate; S, Symphysis pubis.

FIG. 151.



Vesical calculus almost completely filling an hypertrophied bladder.

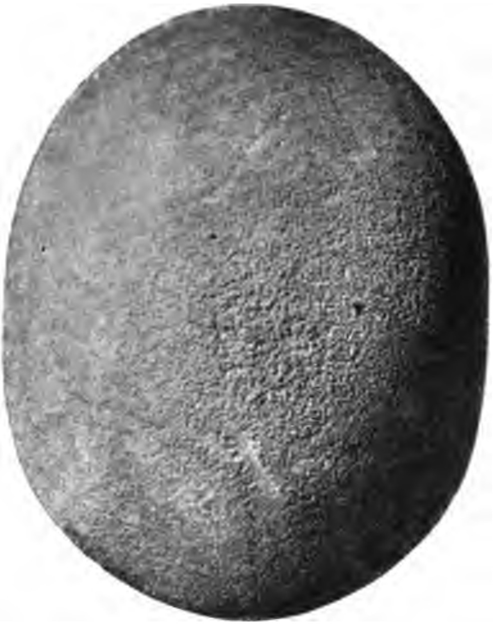
down in the middle line between the recti and pyramidales muscles, dividing the sheath of the rectus and the layer of transversalis fascia which bounds the prevesical space anteriorly; the posterior layer of this fascia should prevent the peritoneum from being seen. The prevesical fat, having been exposed, is stripped upward and backward, carrying the peritoneum with it; unnecessary tearing or bruising of this fibro-adipose tissue favors urinary infiltration and prevesical suppuration. Even under the most favorable circumstances infection of this loose tissue is likely to take place; when the bladder is infected the danger is, of course, much greater.

To avoid prevesical abscess in cases of septic cystitis, Senn advises that the operation be performed in two stages. After exposing the anterior bladder-wall and arresting hemorrhage, the wound is packed with iodoform gauze and dressed antiseptically. At the end of five days the dressing is removed, and, if the wound has remained free from infection, it will be found covered with healthy granulations, which close all channels of communication between the wound and the prevesical space. The bladder is then opened and drained in the ordinary manner. Local anæsthesia with cocaine is sufficient for the secondary operation.

When the operation is completed at one sitting, the prevesical space is flushed with protargol solution 1 to 2000, and the bladder-wall, having been clearly exposed, is hooked up by a tenaculum and an incision is made large enough to admit the index finger. Through each border of the bladder-opening a thread is passed, by means of which the wound can be held forward and kept open. Should it be necessary to enlarge the opening, this may be done with a probe-pointed bistoury. By placing the patient in the Trendelenburg position and using an electric light the entire bladder, including the vesical opening of the urethra, can be inspected in patients who are not unduly fat. The calculus is removed by the scoop or forceps; if it is encysted, it should be shelled out with extreme gentleness, the opening into the bladder from the diverticulum being nicked and stretched should this be necessary. After removing the major calculus, search should be made for any remaining calculi or fragments. Some stones are so large that the parietal incision may be too small for their delivery (Fig. 151); one or both recti tendons should then be cut.

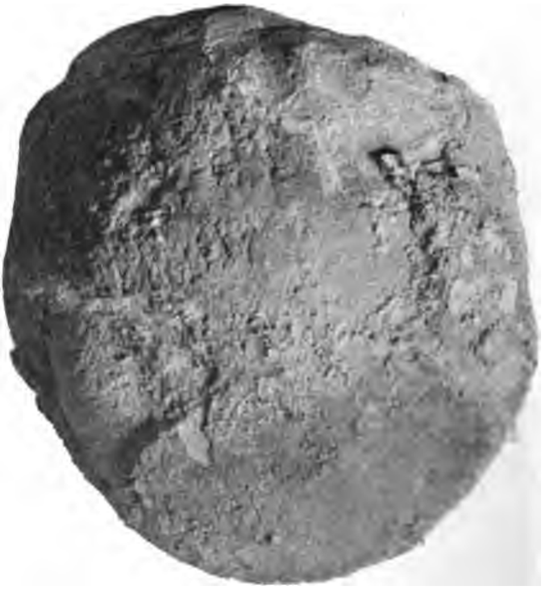
The condition of the prostate should be noted, and any small outgrowths preventing the outflow of urine should be removed, since they are predisposing factors to calculus-formation; their removal lessens the chance of recurrence and frequently relieves troublesome urinary symptoms.

FIG. 152.



Uric acid calculus. Exact size. Weight, nine and one-half ounces. Removed by suprapubic section.

FIG. 153.

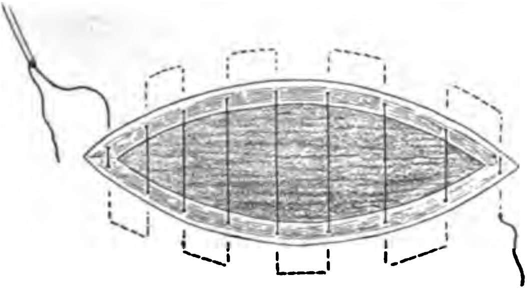


Uric acid calculus. Exact size. Weight, nine and one-half ounces. Removed by suprapubic section.

After-Treatment of Suprapubic Lithotomy Cases.—The after-treatment of the bladder, the stone having been removed, depends upon the condition of its walls. Provided these are in a fairly healthy condition, immediate suture of the bladder-wound is safe. When the surgeon believes before operation that the case is one for immediate suture of the vesical wound, it is well not to carry the incision of the bladder-wall too close to the pubis, for when the bladder collapses the wound may be inaccessible.

A double line of sutures should be used: the first, a running stitch of fine catgut, approximates the cut edges or raw surfaces of the mucous membrane; the knots should be placed on the vesical aspect of the bladder; the second, an interrupted suture of fine catgut, six to the inch, includes everything down to the mucous membrane. To determine whether or not the lines of suture are tight enough, the wound may be filled with water and the bladder distended with air; any leakage will become at once apparent. Should there be doubt as to leakage, the prevesical space may be drained for forty-eight hours by a drainage-tube. When the bladder is infected, provision against the bladder stitches failing to hold should be made by gauze drainage of the prevesical space. This should be removed on the third day, provided the bladder suture holds and the prevesical space remains clean, the parietal wound then being closed by sutures placed but not tied down at the time of operation.

FIG. 154.

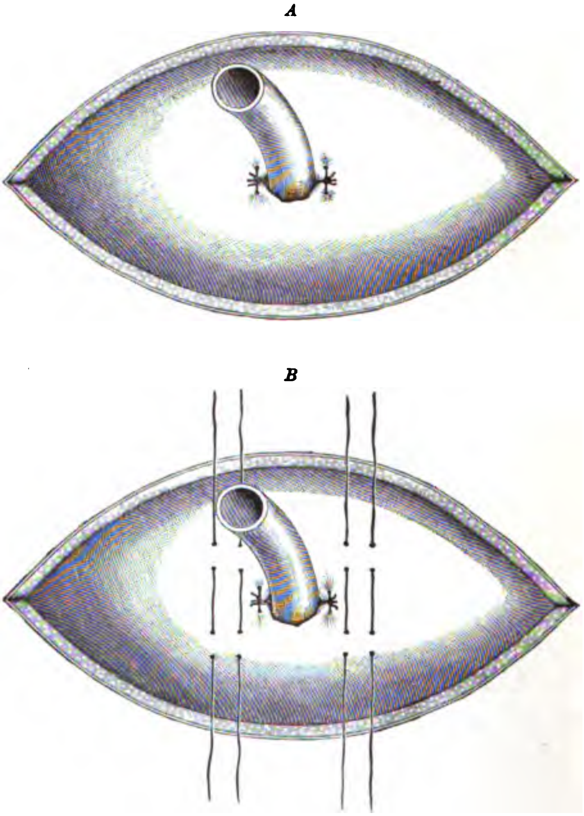


Cushing's suture for closing the bladder.

After bladder suture continuous catheterization is indicated for from three to five days, supplemented by instillations of mild antiseptics if there is moderate cystitis; injections should be avoided.

Should there be marked cystitis and the bladder-walls be in an unhealthy condition, suture of the vesical wound is not advised. In such cases drainage should be secured through the wound until the urine becomes clear or is passed normally through the urethra. To facilitate irrigation, two tubes passing to the base of the bladder and fenestrated for an inch only, are stitched to the most dependent part of the parietal wound; in case one should become clogged the other is available. The bladder-incision is sutured tightly about these tubes; unless this is done the surface of the wound is constantly bathed in urine. To prevent this, Cobbe has suggested capillary drainage. A single glass tube is introduced through the suprapubic incision, its rounded end reaching to the most dependent part of the bladder when the patient is in the dorsal decubitus. This glass drainage-tube is attached to a rubber tube, which is conducted into a bottle of antiseptic solution placed at the bedside. Through these tubes is run a long wick of iodoform gauze. This capillary drainage, though partially successful, will not keep the wound dry.

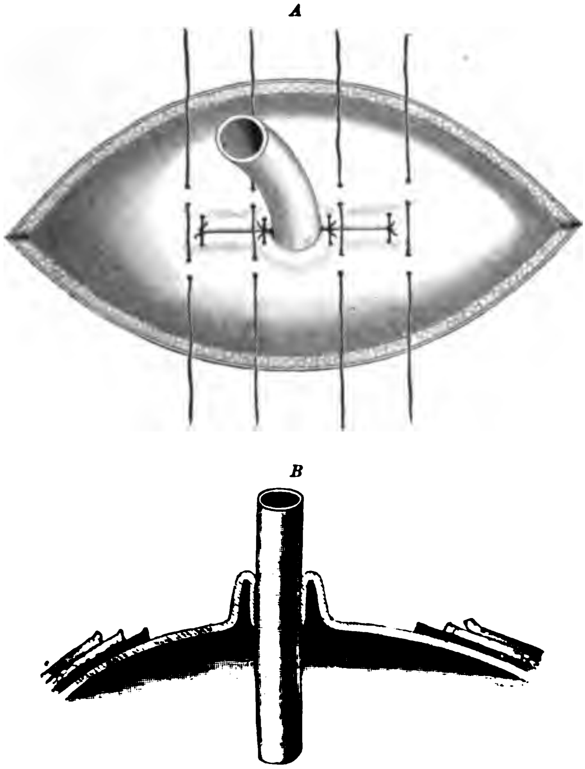
Fig. 155.



Gibson's method of closing the bladder.

Gibson drains the bladder by securing its wall closely around the rubber tube by a single Lembert suture on each side. (Fig. 155, *A*.) Two inversion sutures are placed on each side of the tube. (Fig. 155, *B*.) Two others are then introduced similar to the first. (Fig. 156, *A*.) The ends of these may be either cut or left long, and utilized in closing the abdominal wound snugly about the tube. This method prevents leakage into the prevesical space, and is followed, on removal of the tube, by prompt closure of the wound. The tube drains into a vessel placed below the level of the bladder.

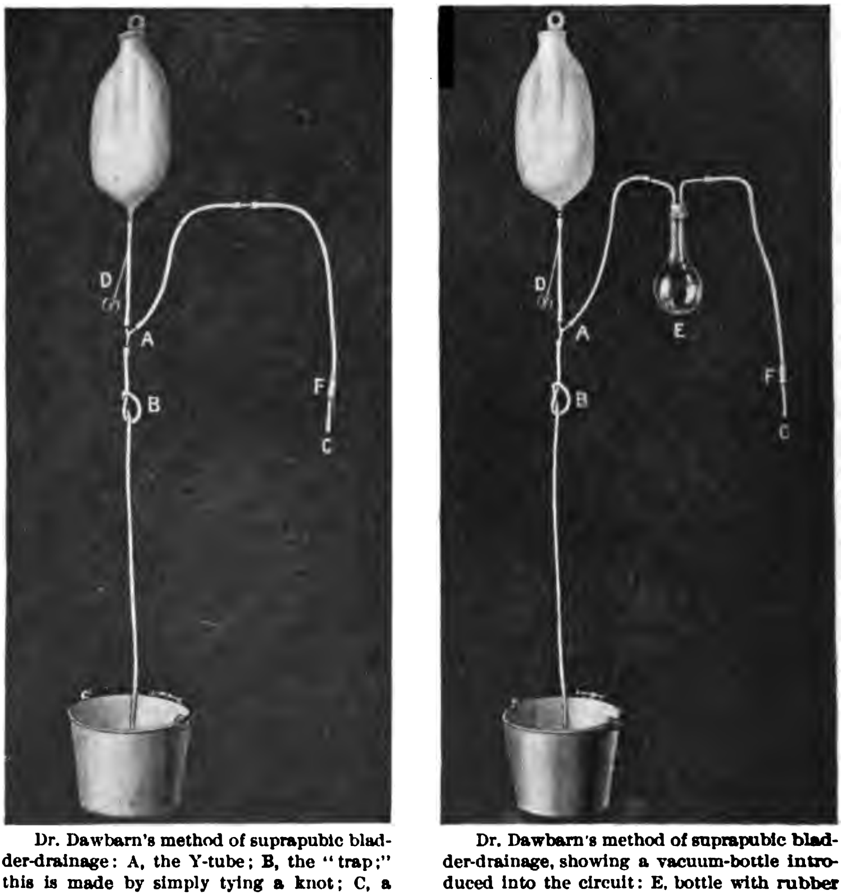
FIG. 156.



Gibson's method of closing the bladder.

Intermittent siphonage is a more efficient method of drainage. Dawbarn accomplishes this by a large fountain syringe and a glass or hard rubber Y connection. A catch just above the Y in the tube allows the liquid in the bag to flow drop by drop. When the trap, a loose knot below the Y, is filled, the next drop starts a siphonage which creates a vacuum between the Y and the bladder, thus emptying the latter. A soft rubber catheter cut across between its tip and eye is inserted into the bladder, and over this a larger drainage-tube which provides for intravesical atmospheric pressure. The two tubes are united by a stitch. The outer tube is held in place by a strip of adhesive plaster passed across the wound and secured to the rubber tube by a stitch. The inner tube is attached to one limb of the Y. The bladder may be washed by loosening the clamp about the Y and pinching the tube below it. By then pinching above the Y and releasing the tube below, the solution flows out. In order to secure the urine undiluted, it is only

Fig. 157.



Dr. Dawbarn's method of suprapubic bladder-drainage: A, the Y-tube; B, the "trap;" this is made by simply tying a knot; C, a catheter with end cut off, thus making two eyes; D, artery forceps; a fountain syringe catch does as well, to regulate the flow; F, short piece of larger tubing; between this and the catheter air enters the bladder freely.

Dr. Dawbarn's method of suprapubic bladder-drainage, showing a vacuum-bottle introduced into the circuit: E, bottle with rubber stopper and two glass tubes. This is used temporarily, at any time, to reckon the flow of urine per hour, and to analyze it undiluted by fluid from the reservoir.

necessary to interpose between the Y and the bladder a large flask with a tightly fitting rubber stopper pierced by two glass tubes. (Fig. 157.)

The drainage-tubes having been placed, the prevesical space is irrigated, carefully dried, and packed with iodoform gauze, the upper part of the abdominal incision is closed by a buried catgut suture through the fascia and muscles and a superficial interrupted suture to the skin and underlying fascia, a dry dressing is applied to the wound, the skin of the lower abdomen is covered with a thick paste of boric or zinc ointment, a large sterile absorbing dressing of gauze and cotton is applied to the hypogastric region, and an oakum pad is placed beneath the patient's buttocks. The bladder should be irrigated with protargol solution and the packing changed every four hours when the urine is foul and constantly escapes into the wound.

When suprapubic cystotomy must be performed for calculus, under circumstances which render the development of cellulitis from infection of the prevesical space probable, it would seem wise, after having irrigated with protargol the prevesical space, opened the bladder, and removed the stone, to close the bladder by suture, even though it be diseased, thoroughly cleanse the prevesical space, pack it lightly with sterile gauze, and drain the bladder by permanent catheterization or by median perineal urethrotomy. If the bladder-stitching is carefully performed, even though definitive union does not take place, the prevesical space will be saved from constant soaking with septic urine for at least three or four days.

Complications and Sequelæ of Suprapubic Cystotomy.—During operation there may be troublesome hemorrhage from the large veins in the perivesical tissue; these are readily secured by hæmostatic forceps. Removal of the rectal bag and evacuation of the bladder-contents are indicated when bleeding is unusually free and from many points; under these circumstances the time spent in trying to secure each vessel is wasted, since the bleeding is due to the venous engorgement caused by the pressure of the bag and the vesical tension. The bladder-wall may bleed freely and persistently, requiring the application of several ligatures.

The peritoneum may be opened; this usually occurs before the bladder has been punctured and while the wound is still sterile. The opening should be closed at once by a fine catgut suture.

Rupture of the rectum by the colpeurynter, if detected, should be treated by immediate cœliotomy and suture.

Shortly following suprapubic cystotomy, the complications common to all operations on the urinary tract may develop,—*i.e.*, shock, collapse, retention, cellulitis, septicæmia, pyæmia, etc.

Prevesical suppuration is a common, often a fatal, sequel. It develops in from three to five days, sometimes with evident symptoms of inflammation and suppuration,—*i.e.*, local tumor, pain and tenderness, and general elevation of temperature. Usually the onset of this complication is insidious, the condition of the patient suggesting uræmia rather than suppuration; local symptoms are but slightly marked, or are completely absent, and the temperature is normal or subnormal.

When prevesical suppuration and advancing perivesical cellulitis are suspected, the suprapubic wound should be opened freely, the space in front of the bladder thoroughly explored and drained, and the bladder itself drained by perineal incision.

The suprapubic wound may refuse to close, leaving a fistula. This rarely happens unless there is obstruction to the flow of urine through the urethra or the suprapubic wound becomes tubercular. The treatment is that generally applicable to vesical fistulæ: urethral obstruction is removed, the bladder is subjected to permanent catheterization, and the fistulous opening is cauterized.

Hernia sometimes follows suprapubic cystotomy, the cicatrix of the parietal incision yielding to intra-abdominal pressure. The transverse cut dividing the attachment of the recti muscles is much more liable to be followed by this complication than is the ordinary vertical incision. It is treated by a truss or by radical operation.

When the bladder is sutured by silk threads, these by escaping into the vesical cavity may form foci for new calculus-formations.

Treatment of Vesical Calculi in Women.—If the stone is quite small, the urethra may be dilated to the required extent, first by suitable dilators, then by the little finger. This being done very slowly, there will be but little laceration of the mucous membrane, and the incontinence that follows will be of short duration. The stone may be extracted by means of a scoop or forceps. If the stone is too large to be removed intact, it may be crushed and washed out in the usual manner. If too large and too hard to be removed in this way, or if the bladder requires drainage, vaginal or suprapubic lithotomy is indicated, but this is rarely necessary. Incision of the urethra and neck of the bladder should never be employed on account of the risk of permanent incontinence.

Kelly thus performs the vaginal operation: The patient is placed in the knee-chest posture; a catheter in the bladder, or speculum in the urethra allows air distention of the viscus. The posterior vaginal wall is lifted well upward towards the sacrum by means of a Sims's speculum, and the anterior vaginal wall is brought into view. An incision into the bladder is made through the vesicovaginal septum. The slight hemorrhage passes into the bladder, and thus the field of operation is kept clear. A stone in the bladder or lower portion of the ureter may be easily removed by forceps or a scoop.

FOREIGN BODIES IN THE BLADDER.

In addition to calculi there has been found in the bladder an almost unlimited variety of foreign bodies, such as fragments of catheter, hair-pins, pipe-stems, lamp-wicks, pencils, spicules of bone, bullets, shot, etc. These may enter the bladder by way of the urethra, may be driven into the viscus by direct violence, or may gain access by a process of ulceration.

Portions of catheter are more frequently found in the bladder than any other foreign body. The breaking of a soft instrument in the urethra or bladder usually occurs when patients catheterize themselves. Either from ignorance or from carelessness, they continue to use a catheter after it has become weak and brittle.

The mechanism by which foreign bodies introduced into the meatus reach the bladder has been described in considering foreign bodies in the urethra. Often the introduction of these bodies is suggested by a form of sexual perversion. Sometimes they are passed in for the purpose of allaying the intolerable itching and burning which are symptomatic of posterior urethritis and are referred to the urethra just behind the meatus.

Foreign bodies driven in by force may be pieces of bone, bullets, shot, fragments of clothing, sometimes splinters of wood. Foreign bodies which enter the bladder by the process of ulceration are fragments of bone and the contents of the intestinal canal. Dermoid cysts and extra-uterine pregnancies sometimes discharge into the bladder. Morris says, "Among surgical catastrophies and miraculous recoveries is the case of a pair of pressure forceps left in the peritoneal cavity at an ovariotomy, in which ulceration of the vesical wall occurred and the forceps entered the bladder and were then successfully removed after a long interval." Morris quotes Guyon and Henriet to the effect that a foreign body once fairly within the cavity of the bladder will usually occupy a transverse position between the summit and the neck and rather nearer the neck. In the empty bladder this is the only position which bodies not longer than four inches can take. A body five inches long assumes either a vertical or an oblique position.

Symptoms.—As in the case of stone, foreign bodies in the bladder may remain quiescent for a long period. Commonly they produce frequent urination, tenesmus and pain, hæmaturia, and, sooner or later, cystitis. If from their shape they exert constant pressure in one portion of the bladder, ulceration and perforation take place, with either the formation of a limited abscess opening externally or into one of the neighboring viscera, or diffuse cellulitis.

Unless the body is expelled shortly after it is introduced, or is of such a nature as to be slowly disintegrated, there is no tendency towards spontaneous evacuation through the urethra. It soon becomes incrusted with urinary salts and grows progressively larger.

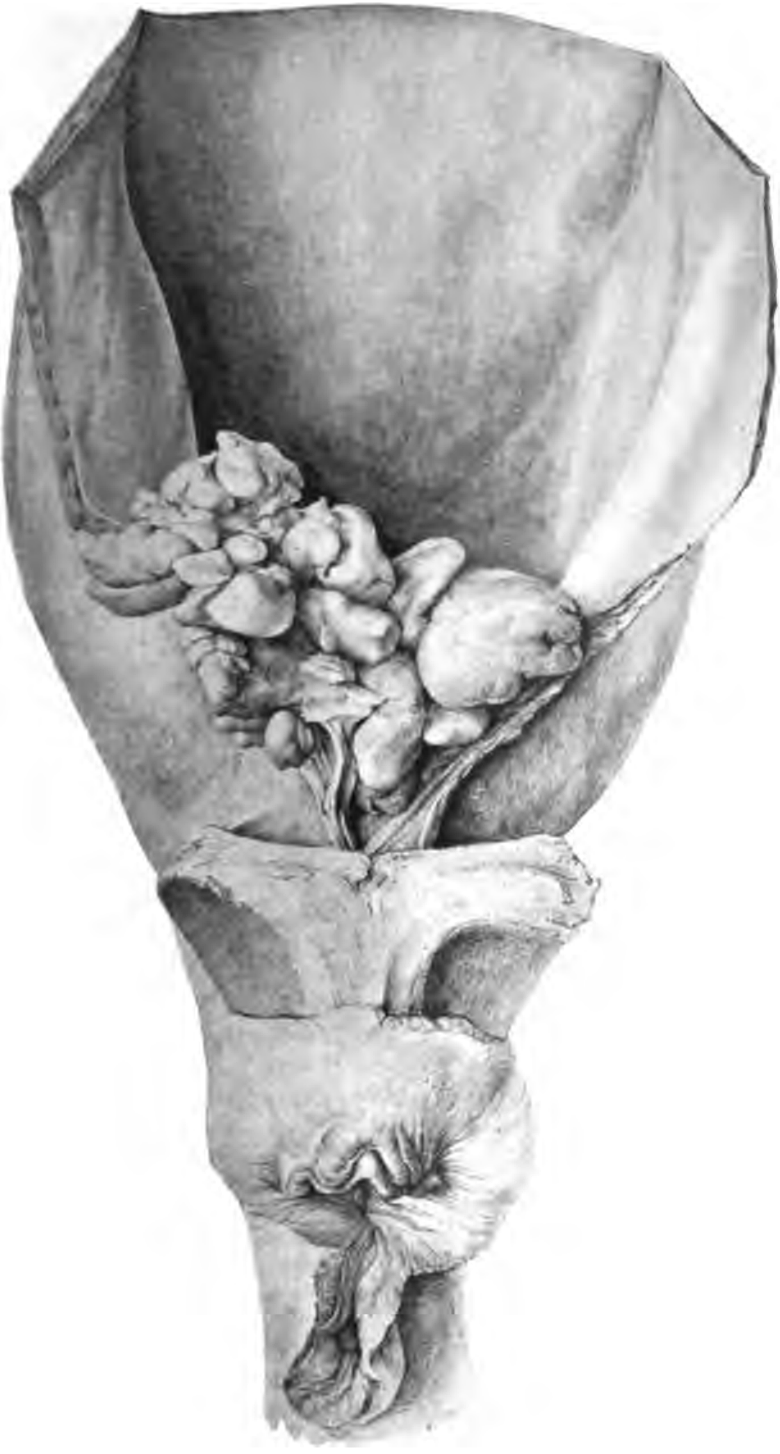
Diagnosis.—There is nothing in the symptomatology of a foreign body to distinguish it from stone. Frequently careful questioning will elicit a history of a catheter having been broken in the bladder, or of a body which has been introduced into the urethra having disappeared, or of a traumatism, such as gunshot wound in the vesical region. In the absence of such history, the diagnosis is sometimes possible after exploration with a vesical sound and bimanual palpation. Thus could be felt a portion of umbrella rib or slate-pencil, for instance. The most reliable means of diagnosis is cystoscopic examination. This will determine the shape, nature, and position of the foreign body, and will enable the surgeon to select the safest and most efficient methods of removing it from the bladder.

When first inserted, foreign bodies are comparatively easy to extract, since there is then no cystitis and little incrustation has taken place. These cases, however, rarely present themselves for treatment until cystitis has reached such a stage as to cause almost unbearable suffering. The body is then thickly crusted with urinary salts.

Treatment.—If the history of the case indicates or if cystoscopic examination shows that the bladder contains a portion of a catheter, it is permissible to attempt first to free it of its incrustation by the gentle use of a lithotrite, and afterwards to grasp it in the jaws of this instrument and remove it. If possible, one end should be seized. To accomplish this the catheter must be grasped repeatedly in various positions, and only very gentle traction must be exerted when the attempt is made to extract it. If properly grasped, it will come without force. If caught in the middle and not crusted, even though doubled, it may sometimes be drawn out without injuring the urethra. If this requires the least force, the attempt to deliver it through the urethra should be abandoned.

Mercier has devised a special instrument for withdrawing pieces of catheter. It consists of two blades like those of a lithotrite. The male blade terminates in a hook with the point directed downward.

FIG. 159.



Myxosarcoma. (Albarran.)

When closed this hook slips into a fenestration in the female blade and the instrument presents a smooth rounded end. The catheter, being grasped transversely, is doubled up and drawn through the urethra.

Foreign bodies, such as seeds, shot, and pieces of twigs or leaves, may be removed by the tube and evacuator employed in litholapaxy. If the body is of such shape or size that it cannot be taken out through the urethra, cystotomy is indicated. Before the advent of cystitis, either the suprapubic or the perineal route may be chosen. If the foreign body is of large size or irregular in shape, or both, the former route is to be preferred. As soon as the body is removed the bladder-wound should be sutured with catgut. Stitches for closing the parietal incision should be introduced but not tied down, the wound being allowed to remain open for three days. If the bladder-suture still holds and the parietal incision is sterile, it is then closed. Permanent catheterization is desirable in these cases, though not absolutely necessary.

When the bladder is infected, or if the foreign body is of such size that it may be readily removed through a comparatively small opening, the perineal incision is the safest. The after-treatment is that applicable to perineal urethrotomy.

In women the greater distensibility of the urethra makes the extraction of foreign bodies much easier. Probably hair-pins are more frequently found than any other foreign body. A special instrument is used by French surgeons for their extraction. (See Fig. 158.)

Fig. 158.

Hook for the extraction of hair-pins from the female bladder.

TUMORS OF THE BLADDER.

Tumors of the bladder may be benign or malignant.

Benign tumors are the papillomas, the adenomas, the fibromas, the myxomas, and cysts.

The malignant growths include carcinomas, sarcomas, and mixed tumors, except the fibromyomas. Carcinomas may be squamous or glandular. The sarcomas may be round-celled, spindle-celled, melanotic, or mixed, as fibrosarcoma, lymphosarcoma, and myxosarcoma. (Fig. 159.)

Of all bladder-growths, more than half are malignant, carcinoma being found more frequently than all other bladder-tumors combined.

Of benign growths, papilloma is commonest. Next in order comes the myxoma, or bladder polyp, adenoma and fibroma are rare.

The seat of bladder-tumors is usually about the base, in the region of the trigonum. Exceptionally, when single, these growths are found involving the upper two-thirds of the bladder-walls. The mode of attachment of the tumor to the bladder-wall varies in different cases. Sometimes it is attached by a long slender pedicle; or the pedicle may be broad, and there may be infiltration of the surrounding bladder-tissues; or there may be no pedicle; or the entire thickness of the bladder may be involved, the infiltration extending beyond the area apparently diseased. Men are more frequently affected with bladder-tumor than are women. The tumors may develop at any age, but are commonest between the fortieth and the sixtieth year.

The great frequency of bladder-tumors in anilin workers has been pointed out by Rehn, twenty-one cases having come under his observation since 1895. Of these, three were benign and eighteen malignant. The patients had been employed in a factory from five to twenty-nine years.

Albarran states that vesical tumors are multiple in twenty-five per cent. of cases. Small, single, well-pedicled tumors are likely to be benign; large, infiltrating, sessile tumors are commonly malignant.

Papilloma.—Papillary tumors are multiple in about forty per cent. of all cases. (Fenwick.) They may be pedunculated or sessile and vary from the size of a pea to that of an orange. They may form a villous surface, made up of closely grouped fine papillæ springing from the mucous membrane, or may appear in the form of a cauliflower growth, each of the papillæ sending out offshoots; in the latter case they usually rise from a comparatively small stalk. It must be borne in mind that all tumors of the bladder may be covered by a villous surface. In the true papillomata, however, the tumor is composed entirely of papillæ. Each papilla is made up of a central capillary loop, together with a stroma of delicate fibrous tissue, covered with layers of cylindrical epithelium corresponding in type with the normal vesical epithelial cells. These papillæ are planted upon a fibro-muscular base, and the whole mass may be sessile, covering a comparatively large area, or may be pedunculated, the stem sometimes being half an inch in diameter. In some cases papillomata form compact masses with villi of only moderate length.

Certain transitional forms are described in which the histological structure of the cells suggests that these tumors may be transformed into epitheliomata. Villous tumors are prone to bleed from partial strangulation of their blood-supply incident to muscular contraction, and from the fact that the delicate, loosely floating papillæ are likely to become detached. These may be encrusted with urinary salts.

Clado calls attention to the fact that papilloma, though classed with the benign tumors histologically, often returns after removal, presenting then the features of an epithelioma.

Myxoma.—This tumor is much rarer than papilloma. It is most frequently encountered in childhood, and is probably in some cases congenital. The myxomata are often multiple and pedunculated, and are much like similar tumors found in the nose. Their stroma is made up of fibrous and mucous tissue well vascularized. They are hard or soft in accordance with the preponderance of the mucous or of the fibrous tissue.

When multiple, several tumors may grow from a single pedicle; this, by elongating, may allow the tumors to slip through the female urethra and appear at the meatus. The mucous membrane about the attachment of the pedicle is not infiltrated. These tumors may recur even after a seemingly thorough removal.

Fibroma.—Tumors of this variety in the bladder are excessively rare. They resemble in structure fibromata formed elsewhere in the body, and are generally sessile; they grow from the muscular coat of the bladder, and are covered with unaltered mucous membrane or villi. They invariably occur in adults.

Myoma.—Myomata of the bladder were supposed by Virchow to be merely prostatic outgrowths, but Belfield has demonstrated that there may be myomata of the bladder pure and simple. They are seldom pedunculated, but are protruded from the muscular coat, often appearing on the outside of the organ as well as in the interior. They sometimes attain a large growth, sufficient to be mistaken for a uterine fibroma, and are extremely vascular.

Sarcoma.—Tuffier quotes Fenwick, who has collected fifty cases of vesical sarcoma, as saying that in children these growths are often multiple, sessile or subsessile, generally polypoid in form; in the adult they are more often simple than multiple, and are pedunculated in only ten per cent. of cases. In thirty-four and a half per cent. of cases they are of the round-celled variety, and in almost seventeen per cent. spindle-celled. They attain a considerable size, sometimes that of a fœtal head. They are generally composed of purely sarcomatous elements, yet villous papilloma degenerating into sarcoma has been observed. Sarcomata are usually multiple. They commonly grow from the neighborhood of the ureteral orifices, or from the mucous membrane lying between these openings. In women infiltration frequently extends along the urethra. From its rapid growth, sarcoma is likely to pass beyond the limits of the bladder, invading the pericystic tissues and finally the bones of the pelvis.

A few cases of angioma, enchondroma, and lymphadenoma have been noted.

CARCINOMA.—This may appear in the form of squamous or tubular (lobulated) epithelioma or alveolar cancer (carcinomatous epithelioma). (Figs. 160, 161.)

Vesical cancer is usually sessile, involves the whole thickness of the bladder-wall, and presents an uneven, often ulcerating, surface; it is hard on palpation, is surrounded by peripheral induration, and is frequently multiple. The growth is extremely slow. Extensive ulceration is rare; metastasis is also sometimes entirely wanting. The affection occurs most frequently in men, and between the fiftieth and the sixtieth year.

At times the growth is pedunculated, suggesting the appearance of papilloma.

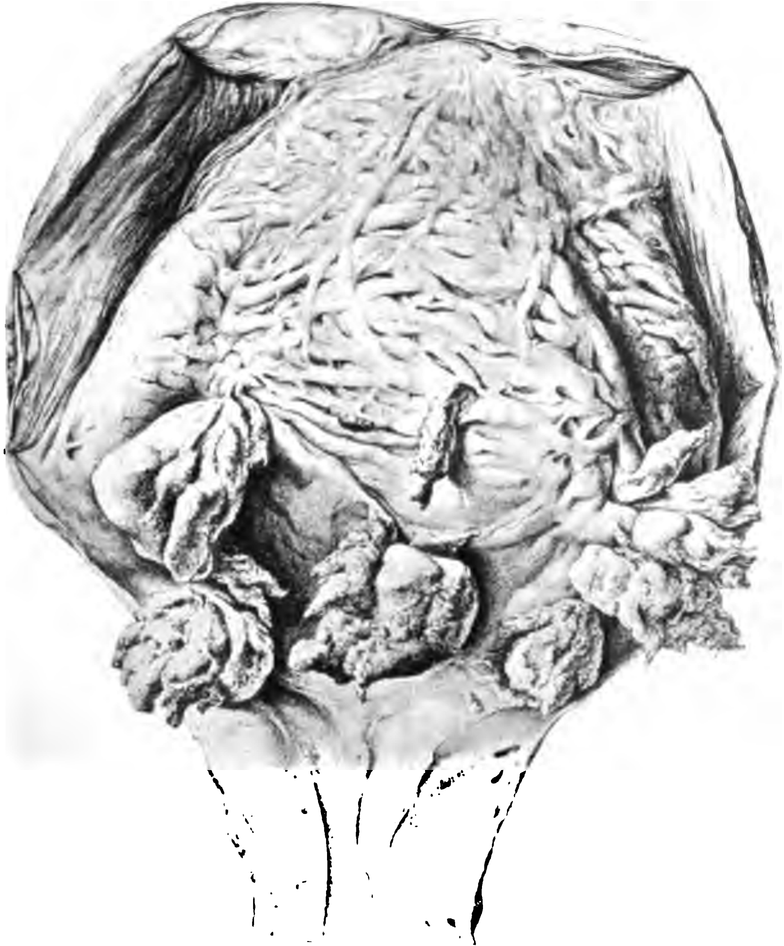
On intravesical examination these growths are found to 'vary greatly in appearance. They may form irregularly projecting masses covered with normal mucous membrane, or they may appear as comparatively flat areas of induration, the surface of which may be smooth or ulcerated. In some cases there is bulk sufficient almost entirely to fill the bladder; very frequently the surface is covered by a papillary growth. Infiltration and induration are the most characteristic features.

When by rectal examination a hardening of the bladder-wall can be felt, this is almost pathognomonic of cancer.

Although extension of the disease to the iliac and abdominal glands and thence to the abdominal viscera occurs, extension to neighboring organs appears to be rare. Watson quotes Barling to the effect that in only three out of fifteen cases of carcinoma of the bladder did extension to neighboring organs occur; and in nine, in the same series of cases, secondary deposits were found in other organs. Of forty-nine cases, thirty-three had, as secondary changes, hydronephrosis or pyonephrosis, or both.

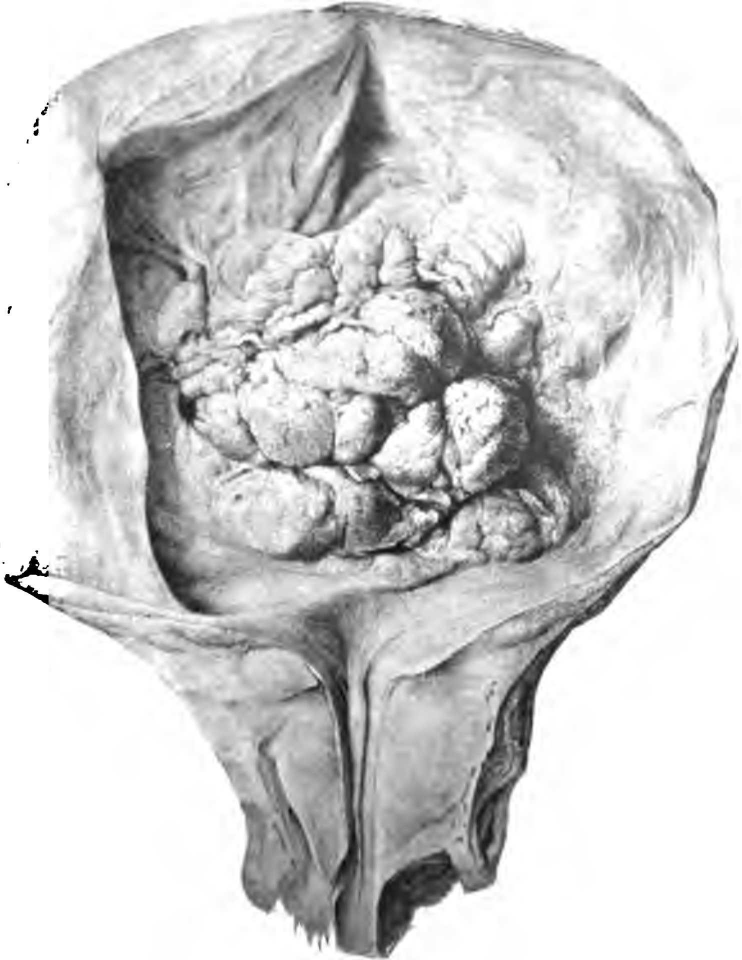
Watson adds, "The remarkable tendency of carcinoma of the bladder to remain localized for very long periods has been commented on by various writers, and is generally explained by the absence, according to some investigators, or by the meagreness, according to others, of the supply of lymphatic channels in the bladder. Barling quotes Hoggan with reference to this matter as follows: 'There is but one set of lymphatic vessels over the bladder, except at the tri-

Fig. 160.



Lobulated papilloma (epithelial cancer). (Albarran.)

Fig. 161.



Carcinoma (epithelial cancer). (Albarran.)

gone. This single layer commences on the deep or mucous surface of the muscular coat, beginning as loops or chains around the smaller arteries or veins within that coat, as though destined to absorb their exudations rather than those of the mucous membrane. These lymphatics concentrate into two main sets, one going back to the neck of the bladder, the other towards the urachus.' These are said by the text-books to empty into the internal iliac glands, but Hoggan says this is incorrect. At the trigone there is a second set of purely collecting lymphatics arising in the mucous membrane and connecting with the deeper set. This lack of direct connection of the larger portion of the lymphatic channels with the mucous membrane explains the failure of the neighboring glands to become involved in some cases or their tardy infection in others. This also explains the extraordinarily long course of the disease that has been noted."

Symptoms.—The benign bladder-tumor may exist for years and excite no symptoms.

Usually hemorrhage is a symptom which first suggests the possibility of a bladder-growth. This hemorrhage occurs without apparent cause, its onset is sudden, and it disappears as quickly as it comes. If the bleeding is copious, if the last urine passed contains more blood than that first evacuated, if the blood is bright red in color, if clots are passed, and if gentle instrumentation occasions free hemorrhage, all the characteristic features of bleeding from bladder-tumor will be present.

This bleeding may last a day, or may continue for weeks, may be so slight as to excite no constitutional symptoms, or may be severe. Exceptionally, as a result of intravesical bleeding, dense clots so obstruct urination that immediate operation is necessary. Frequent recurrences of the bleeding may exhaust the patient, and may finally occasion death. It must be borne in mind that the amount of bleeding is by no means commensurate with the size of the tumor. At times, in place of hæmaturia, or associated with it, there is what Ultzmann calls fibrinuria,—that is, in place of pure blood the albuminous constituents of this fluid are exuded through the distended vessels in the region of the growth. The urine when passed coagulates.

Pain usually is not severe, except when there is accompanying cystitis. It is especially marked when the tumor is placed in the region of the vesical neck and is reflected to the hypogastric region, the anus, the testicle, the penis, and down the thighs. It is most marked on the completion of urination and when the bladder is invaded by a malignant growth. Benign tumors often cause no pain.

Frequent urination is not a constant symptom. When noted it is not aggravated by exercise, and is not more marked at night. Pain and frequent urination are constant and distressing symptoms when the bladder has become infected; they are then due to the cystitis rather than to the tumor.

The passage of fragments of the tumor is the only absolutely conclusive sign of bladder-tumor, aside from direct examination. A microscopical examination is necessary to determine the nature of the fragments passed, since coagulated fibrin or blood-clot may readily be mistaken for a new growth when examined macroscopically.

Diagnosis.—This is founded on the sudden, apparently causeless free bleedings recurring with increasing frequency, the passage of tumor-fragments, examination with the cystoscope (see Cystoscopy), combined rectal and suprapubic palpation in the case of malignant growths (see p. 445), and exploratory perineal or suprapubic cystotomy. Myxomata and non-infiltrating growths cannot be detected by palpation.

The passage of irregularly shaped clots, superabundance of epithelial cells, absence of fragmentation in the blood-corpuscles, absence of kidney albumen, and the presence of absorption bands of oxyhæmoglobin on spectroscopic examination, would indicate at least the vesical origin of the bleeding.

The successive appearance of single symptoms strongly points to vesical tumor; the immediate association of several symptoms is the rule in cystitis. In the latter the appearance of pus is never long delayed; in tumors it is often delayed. In tumors that infiltrate the bladder-wall, in contradistinction to pedunculated neoplasms, hemorrhage may be a late symptom, while, on the other hand, the irritation of the muscular wall induces frequent urination at an earlier period than in tumors with a pedicle. Hæmaturia, intermittent or profuse and lasting a long time, without other symptoms, is always suggestive of vesical tumor rather than of cystitis. There may be little hemorrhage in some extensive tumors of the bladder, but every neoplasm of the bladder must at some time be associated with more or less bleeding, usually more than in cystitis. In any case in which doubt exists, if the usual treatment for cystitis is not followed by benefit, a tumor is probably present.

A bladder which contains a tumor is peculiarly susceptible to infection, and, as the supervention of cystitis greatly increases the suffering of the patient and adds materially to the risk of surgical intervention, it is best in suspected cases to pass no instrument into the bladder until all preparations are made to operate at once in case a tumor is found.

Prognosis.—In even benign tumors the outlook of a case allowed to run its course is unfavorable. Very exceptionally individual polypoid growths are discharged spontaneously. As a rule, the growth is progressive. Freyer mentions a case of papilloma existing eighteen years.

From mechanical action a large tumor of the bladder may cause displacement of neighboring organs, pressure upon the rectum, or partial or complete obliteration of the ureters or the urethra. Cystitis is a constant accompaniment, and is usually severe. The common cause is uncleanly catheterization. It is sometimes complicated by a pericystitis, causing fibro-adipose deposits, which limit the movements of the bladder.

The patient ultimately perishes, either from exhaustion incident to hemorrhage or from ascending pyelonephritis. The course of these cases is often extremely slow.

When the tumor is thoroughly removed the prognosis in benign cases is good, though recurrence may take place. Even in malignant growths a thorough removal in the early stages may accomplish radical cure.

Treatment.—It is of cardinal importance in cases of suspected bladder-tumor to avoid infecting the vesical mucosa when such infection has not already taken place. The diagnosis having been established, there is but one treatment to be seriously considered,—complete removal of the growth.

The palliative treatment of tumors of the bladder is confined to checking bleeding and relieving pain. This treatment may be required because of reluctance on the part of the patient to consent to operation; more frequently because by the time a positive diagnosis of tumor is made infiltration has already extended wide of the bladder, and a radical operation is no longer possible. The treatment of hæmaturia in general is that applicable to the relief of vesical congestion. Direct local treatment may be conducted by hot injections of alum four drachms to the pint, hydrastis two ounces to the pint, or acetanilid five per cent. solution, or adrenalin solution 1 to 5000. When clots are present and produce retention, they should be aspirated through a catheter or litholapaxy evacuating tube. If bleeding persists in spite of injections, or if these produce great pain and seem to increase hemorrhage, permanent catheterization is indicated. If this is unsuccessful because the catheter becomes blocked by clots, perineal drainage, with the insertion of a large tube, is advisable. Through this tube the bladder can be abundantly flushed with comparatively strong astringent injections. Should these means fail to arrest the bleeding, and should life be immediately threatened by its continuance, the bladder should be opened above the pubis, the edges of the vesical wound sutured to the parietal incision, and, drainage-tubes having been carried to the region of the ureters, the bladder should be firmly packed with iodoform gauze.

Pain may be quieted by instillations of cocaine. Usually morphine hypodermically will be required for its relief. Cystitis or retention should be treated in accordance with the directions already given.

The use of astringents by the mouth is sometimes serviceable in lessening hemorrhage; hydrastis, ergotin, and gallic acid may possibly exert some local influence.

Operative Treatment.—The method of reaching the tumor will depend upon its size, location, and nature. It may be approached through the urethra, through a median perineal opening into the membranous urethra, or through a suprapubic opening.

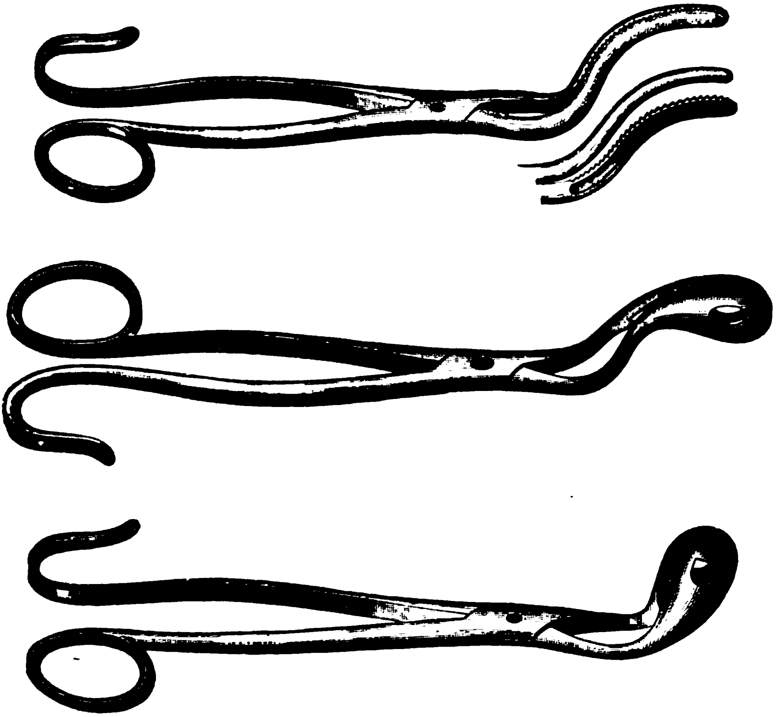
Removal through the urethra has been successfully accomplished in the case of small pedunculated individual polypoid growths. It is uncertain and not to be commended. The instrument commonly employed is the lithotrite, the location of the tumor having been previously determined by a cystoscopic examination.

The perineal route, highly commended by Thompson, and primarily employed by him for diagnostic purposes, is serviceable for the removal of polypoid growths, especially when these are placed near the vesical orifice, though when the perineum is not unusually deep and the bladder is not pushed up by an enlarged prostate, a finger passed through this opening into the bladder and aided by pressure above the pubis with the other hand can make an examination of every portion of the vesical mucous membrane. The advantages of this route are its much lower mortality and the thoroughness of the drainage which it provides. Its disadvantages depend upon the fact that the surgeon is forced to operate through a small opening, —*i.e.*, the undivided neck of the bladder,—and that he must depend entirely upon the sense of touch.

For the seizure and removal of growths by this route polypus forceps with serrated blades are employed, straight and curved (Fig. 162); also forceps with cutting edges are used when the growths are more dense and less distinctly pedunculated. The patterns furnished by Thompson are the best (Fig. 162.) The growth is removed by introducing the forceps into the bladder, opening them widely, and then closing them as near the region of the base of the polyp as can be calculated. By firmly grasping the polyp it may be removed by the forceps aided by twisting; forcible traction should be avoided, and Thompson especially cautions against exerting suprapubic pressure while the forceps are introduced in search of polypi, since thus a fold of the bladder may be grasped and crushed, resulting possibly in perforation and fatal peritonitis. As each portion of the growth is removed the finger should be inserted, to determine exactly how much has been accomplished. Sessile growths, especially if extensive, are, of course, not amenable to this operation.

For the performance of suprapubic cystotomy for the removal of vesical tumors, the surgeon should be provided with a rectal bag, a catheter of medium calibre which will enter the bladder without difficulty, a four-ounce syringe the nozzle of which fits accurately into the catheter, two broad retractors, an electric light, two glass vaginal specula, special crushing or avulsion forceps, a wire écraseur, the Paquelin or galvano-cautery, and the ordinary operating instruments, —*i.e.*, knives, scissors, hæmostatic forceps, tenacula, straight and curved needles, a needle-holder, and a grooved director.

FIG. 162.



Thompson's forceps for removing vesical tumors.

The incision is the same as that already described in treating of suprapubic cystotomy for the removal of large calculi.

It is at this stage of the operation that the Trendelenburg position becomes useful, the rectal bag being removed if this has been used. With an irrigator and sponges the bladder is cleansed of blood-clots and dried. The electric light is then turned on, and the interior of the bladder is inspected. This portion of the examination may be greatly facilitated by the use of a glass speculum, as suggested by Fenwick. The instrument selected is from an inch to an inch and a half in diameter; it is passed into the bladder, and is used on the principle of a caisson,—that is, its end is held in contact with the mucous membrane, and the portion thus included is thoroughly dried by sponging. This portion can then be inspected, since no further obscuration with blood or urine is possible until the speculum is lifted from its place, unless it includes the bleeding area or the orifice of the ureter.

When the bladder is small and not distensible, as is the case after prolonged interstitial cystitis, or when from the size of the tumor it is obvious that more room will be required than is given by the ordinary vertical incision, the transverse cut may be made. (Trendelenburg.) This is four inches long, slightly convex downward, and is carried along the upper border of the symphysis. The attachments of the recti muscles are divided, and the prevesical space and the bladder are both opened by a transverse cut. This gives a larger vesical wound without endangering the peritoneum, and consequently makes intravesical manipulations easier. The bladder-wound, which should be almost as large as that of the parietes, should be temporarily sutured to the latter.

The incision of choice for bladder-tumor is either the vertical or the transverse. The latter gives a wider exposure, is easier of performance, and is less likely to be complicated by wound of the peritoneum. It is open to the objection that it materially weakens the belly-wall and is liable to be followed by hernia.

Pedunculated growths so placed that the bases cannot be well excised may be removed by Watson's galvano-cautery scissors or by the écraseur, in the latter case their pedicles being destroyed by the actual cautery. The bases of extensive sessile growths which have been removed by the knife or the curette may also be cauterized.

When the tumor infiltrates the whole thickness of that portion of the bladder-wall which is covered by peritoneum, this investment should be dissected up and partial resection of the bladder practised. When the peritoneum also is involved, this must be included in the resection. The tumor having been pulled forcibly outward, a clamp is applied tightly to the inverted bladder-walls entirely beyond the growth, thus forming of these walls an artificial pedicle. The peritoneal cavity is then opened, and the surfaces of the vesical peritoneum which are apposed by the inversion and clamping of the bladder are secured by a double row of catgut sutures. The peritoneal cavity is closed, and the tumor is removed by cutting through the whole thickness of the inverted bladder-walls. Vessels which bleed freely may be ligated; usually a continuous catgut suture so applied that the cut surfaces are accurately apposed will check hemorrhage.

When the tumor infiltrates the base of the bladder about the ureteral orifices, its thorough removal is often impossible without division of the ureters. This is not, however, an absolute contra-indication to an attempt at radical cure. In case of wide-spread disease the entire bladder has been resected. A total resection reported by Pawlik is most noteworthy, since the result was entirely satisfactory. The ureters were freed from their bladder attachments and stitched into the vaginal wound; later, through a suprapubic incision, the bladder was dissected free of its peritoneal and fibrous attachments and was cut away from the urethra. Catheters were passed through the urethra into the ureters, and the vagina was closed externally. A fistula remained, which, after several operations, became so small that urine escaped only when the patient was standing. The artificial bladder was able to retain twelve ounces of urine. Pawlik made a final report of this case two years after operation.

When the tumor is limited to the ureteral region and there is reason to believe that its thorough removal may be followed by a permanent cure, resection is indicated even though the ureter is necessarily divided.

Clado, after a careful consideration of the methods of disposing of the ureter when malignant tumor involves the bladder in the region of the ureteral orifice, comes to the following conclusions: Leaving the ureter open in the wound after extirpation of a neoplasm is extremely dangerous. Implantation into the rectum is almost invariably fatal. Implantation into the colon is more successful, having thus far given four successes. Implantation into the parietal wound is sometimes a matter of necessity. Implantation into the vesical cavity and anastomosis with the ureter of the other side are the two operations which give greatest promise of definite recovery.

Albarran proposes ligature of the ureter and consequent destruction of the secreting substance of the kidney of that side, holding that the danger of this operation is much less than that of nephrectomy. He thus summarizes the general treatment of malignant tumors of the bladder: The patient should be placed in the Trendelenburg position and the neoplasm subjected to an examination. If the tumor is sessile, if no enlarged ganglia are found, and if the patient is in good condition, resection of the bladder-wall is indicated. This resection is easily performed if the tumor is placed above the opening of the ureters, since it is then usually accessible, enough room being secured by an incision through the attachments of the recti muscles. When the tumor is placed posteriorly in a bladder which is naturally deep-seated, or about the ureteral orifice, or behind the anterior wall of the bladder masked by the pubic symphysis, partial resection of the symphysis or symphyseotomy may be required.

Resection of the tumor is easiest when it is situated upon the upper portion of the bladder, where the peritoneum can be readily stripped back. After this stripping, the tumor with a portion of the healthy bladder-wall is cut away with scissors and the wound is sutured. If the tumor is placed above the ureters posteriorly, it may be circumscribed by an incision through the mucous membrane and resected from within outward, no effort then being made to strip the peritoneum first. If the tumor is placed about the orifice of the ureter, the latter should be catheterized, should then be exposed by cutting through the lateral wall of the bladder, and should be freed and implanted into a healthy portion of the viscus. (See section on Ureters.) If this operation is impossible, the wound made through the bladder-wall for the purpose of exposing the ureter should be closed, and the urine escaping through the ureteral catheter should be examined carefully. If this urine is clear, showing that the kidney is not infected, the catheter should be withdrawn, and the ureter should be ligated and divided below the ligature. If the urine escaping through the catheter is turbid, showing admixture of pus, the ureter should be divided and fixed to the abdominal wound. L. Fraenkel advises that when the ureter is ligated, the renal end should be brought out at the skin incision and fastened, to provide for the relief of hydronephrosis which is sure to follow, and is sometimes productive of uræmia. The distal divided end may be cauterized and invaginated. Whatever procedure is employed for the purpose of giving more room, the bladder should be closed completely, a permanent catheter should be introduced, and the prevesical space should be packed with iodoform gauze. Total resection of the bladder is indicated only in the case of multiple epitheliomata which have not yet extended beyond the muscular wall.

The tumor having been removed, and hemorrhage having been stopped by suture, ligature, cautery, or packing, drainage is provided for by tubes passing through the suprapubic opening, by the permanent catheter, or by perineal urethrotomy. The bladder-wound is closed by interrupted catgut sutures, placed about a quarter of an inch apart, beginning below and passing upward. These sutures include the whole thickness of the bladder, except the innermost layers of the epithelial coat, and bring into accurate apposition the cut surfaces; inversion or eversion must be carefully avoided. The proper placing of these sutures is much facilitated by the loops placed in the margins of the bladder-wound for the purpose of retracting it.

Guyon sutures the bladder closely about his siphon drainage-tubes. These are made of rubber, are one and a half feet long, and of calibre 14 F. They are adherent to each other for about one inch at the vesical end, and are so curved that the extremity passes downward and backward to the most dependent part of the bladder. The external portion passes over the pubis downward between the thighs, and the two unattached ends are plunged into a urinal containing antiseptic solution. Each of these tubes is provided with an eye near the end of the vesical extremity, and each is notched on its end. They are placed vertically one above the other, and one usually proves the better drain. Before closing the parietal wound, the fact that these tubes are patulous is determined by injecting fluid into one of them; this should flow out through the other, and not through the bladder-wound beside the tubes. The external wound is then closed by a double row of sutures, one buried, of catgut, including the muscles and deep fascia, the other, of Chinese silkworm-gut, including the skin and its underlying fascia. The prevesical space is drained by gauze packing carried through the lower angle of the wound, which is left open. The siphon tubes are secured to the skin by sutures which are loosely knotted.

This is the method of treatment practised by Guyon, and he states that drainage is so perfect that the dressing remains dry and need not be changed for several days. The external dressing is made up of sterile iodoform gauze, secured by an abdominal binder or double spica of the groin. The patient is placed on his back in bed, the free ends of the siphon tube are placed in an antiseptic solution in the urinal, and every three or four hours the bladder is gently washed out. The dressing is changed the fourth or sixth day, the siphon drainage-tubes are removed, and continuous catheterization is practised. The vesical opening is usually closed within two weeks. Many surgeons advise an attempt at complete suture of the bladder. The rules formulated in considering the after-treatment of suprapubic cystotomy for vesical calculus are applicable when this operation is undertaken for tumor. When the bladder is healthy, the urine non-infected, the wound left after extirpation of the tumor completely closed by suture, and the operation has not been extensive, immediate vesical and parietal suture and permanent catheterization are indicated. When the bladder is infected, but the operation has not been extensive, immediate vesical suture, with drainage of the prevesical space and the insertion of a permanent catheter or of a large perineal tube, is indicated. When operation has been extensive, the suprapubic drainage is advisable. Neither the T tube of Trendelenburg, the siphon drainage of Cathcart, capillary drainage, nor any other form of drainage accomplishes what Guyon and Albarran claim for their siphon tubes.

Clado has collected twenty-nine cases of partial cystectomy, with twenty operative recoveries and nine deaths, and five cases of total cystectomy, with two recoveries (both in women) and three deaths (all in men). The mortality in cases of ligation of one renal vessel or ureter is higher than after nephrectomy, apparently due to auto-nephro-toxins. After ligation there are noted degenerative changes in the opposite kidney, the so-called sympathetic nephritis. After nephrectomy these changes are not observed.

EXTIRPATION OF THE BLADDER.—Hartley collected twenty three cases of complete removal of this organ for malignant disease. The total recoveries were twelve, giving a mortality of forty-seven and eighty-three one hundredths per cent. Five patients died during operation, three of collapse afterward, and four a few days later.

The ureters were implanted into the bowel in eleven cases with six deaths, and into the vagina in seven cases with one death from shock.

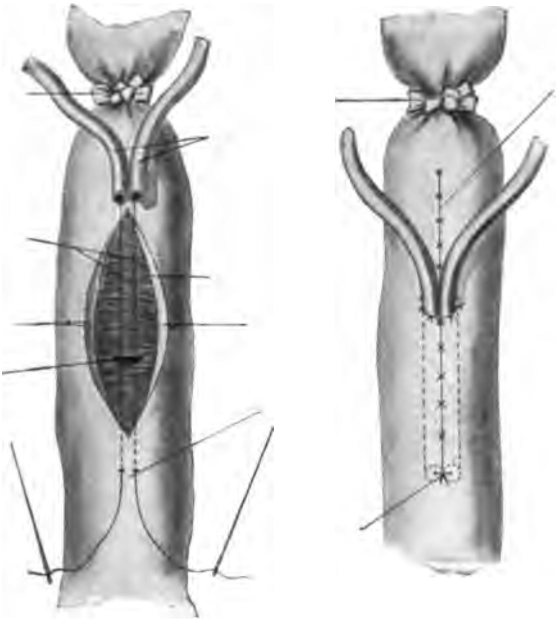
The operation is indicated only in cases in which complete removal of the malignant disease is impossible by partial resection, and in which it is possible to remove all the disease by cystectomy. It is contra-indicated when the malignant disease has extended beyond the bladder, at least when more than the prostate and seminal vesicles are involved.

Preparation of the Patient.—The bowels and bladder should be thoroughly emptied and cleansed with antiseptics. The lower abdomen, perineum, and external genitalia are thoroughly prepared according to the usual routine, and immediately before operation the bladder is filled with an antiseptic solution.

The instruments required are three scalpels, small and large hæmostats in abundance, Spencer Wells forceps, tissue forceps, catheters, four retractors, an electric light, a Paquelin or galvano-cautery, scissors, tenacula, a blunt dissector, straight and curved, round and flat needles, heavy and fine silk, chromicized catgut, silkworm catgut, volsella forceps.

The patient is placed in the Trendelenburg posture, the bladder is distended, and a vertical incision four or five inches long is made in exactly the median line as in suprapubic cystotomy, but extending higher. This exposes the bladder and the reflection of peritoneum, the latter being pushed well upward. A transverse incision is made from the lower end of the wound, dividing all the parietal structures to each external inguinal ring just above the pubic bone and Poupart's ligament. The rectangular flaps thus outlined are dissected and retracted upward and outward to allow free access to the bladder. While moderate traction is made upward on the lateral aspects of the bladder, the anterior wall is separated by blunt dissection from the pubis down to the vesical neck, which is exposed, isolated, and clamped tightly with two pairs of Spencer Wells forceps. The neck of the bladder is divided between the forceps and each stump cauterized. The peritoneum is carefully peeled and removed from the superior,

Fig. 163.



Implantation of the ureter into the bowel.

posterior, and lateral aspects of the bladder by blunt dissection, preferably with the finger, avoiding opening the peritoneal cavity. The inferior vesical arteries and ureters are secured close to the bladder with large curved hæmostats and divided between the forceps *en masse.* The ureteral openings are cauterized at each end and the vesical arteries ligated, after which the base of the bladder may be carefully separated from its attachments and the viscus removed. The ureters are implanted into the sigmoid (see ureteral implantation), the stump of the urethra ligated, all bleeding stopped, and the deep wound packed tightly with gauze, the drainage being brought out just over the symphysis. Both transverse cuts and most of the median incision may be sutured, and the external wound dressed.

Harris advises, especially if the prostate is involved, division of the urethra at the triangular ligament while traction is made on the bladder anteriorly, and removing the bladder and prostate together, these being separated from the rectum while an assistant's finger is inserted in the latter. He would also endeavor to preserve the portion of the bladder-wall into which the ureters empty and suture this as near as possible to the posterior portion of the urethra in the hope that it may ultimately regenerate into a serviceable reservoir.

COMPLICATIONS AND SEQUELÆ.—These are similar to those described under suprapubic cystotomy for the removal of stone. Since an operation for the removal of tumor is prolonged and is often attended by profuse hemorrhage, shock and collapse are particularly to be guarded against. Should the patient escape these dangers, suppression of urine, urinary fever, or infection of the kidneys may develop. The most frequent complication is, however, urinary infiltration with cellulitis. Should symptoms point to these conditions, the hypogastric wound should be opened and the space of Retzius thoroughly drained.

Cystic Tumors of the Bladder.—The most systematic and detailed study of these rare growths is found in Clado's treatise on Tumors of the Bladder. His teaching in regard to them may be outlined as follows:

Cysts are of epithelial origin, or arise from fœtal inclusion (dermoid cysts).

EPITHELIAL CYSTS are equally common in men and in women, are observed during any period of life except in early infancy, and are most frequent between the thirtieth and fiftieth years. They are usually placed about the base of the bladder in the region of the vesical neck, probably because the vesical glands are particularly abundant in these regions. They may occupy the entire vesical cavity, and sometimes are associated with cysts of the kidney pelvis. Clinically, they are distinguished according to size, as small or large.

Small cysts appear as minute or medium-sized vesicles filled with clear fluid. This may become turbid or even blood-stained. They may be due either to alteration of the normal vesical glands producing cysts of retention, or to local epithelial proliferation, followed by central softening.

Large epithelial cysts show a tendency to become enucleated from the vesical wall and form pedunculated growths. Vincent records a case in a child between three and three and a half years old in whom the pedicle was so long that the cyst passed through the urethra and presented in the vulva.

DERMOID CYSTS may invade the bladder primarily or may be paravesical, communicating with the bladder by an orifice. Over forty cases have been reported. These cysts are nearly always observed in women, and symptoms develop between adolescence and old age. The tumor is usually placed at the base of the bladder. Sometimes it appears in the form of a polyp; that is, it is pedunculated. In this tumor hair and fragments of bone may be seen. These cysts always contain hair, and the passage of this in the urine constitutes a major symptom. Fragments of bone and teeth are also at times passed.

Microscopically, these cysts show the structure of skin which contains sebaceous glands and hair-follicles in a state of physiological activity. Even small tumors may discharge comparatively large quantities of hair for a long time.

Thirty-two cases of paravesical dermoid cysts have been collected by Clado; seven originated in the ovary, seven formed paravesical tumors; in eighteen the only symptom recorded was micturition of hair.

The dermoid cyst usually remains latent until about the twenty-first year, symptoms of the tumor becoming manifest between this and the fortieth year. The tumor is usually placed in the recto-vesical septum, beneath the peritoneum. In two cases it was placed on the apex of the bladder, between the peritoneum and the vesical wall. Sometimes these cysts reach huge dimensions, extending above the umbilicus, and weighing over fourteen pounds. Hair, fat (sometimes resembling soap), teeth, or fragments of bone are constantly discharged into the bladder. In one case, owing to pressure, retention developed. Calculi frequently form, having for their nuclei masses of hair. These cysts are usually complicated by cystitis of varying degrees of intensity.

VARICOSE VEINS OF THE BLADDER.—Aside from the enormous distention of the venous plexus around the bladder, which accompanies prolonged vesical tenesmus and enlarged prostate, there have been observed a few cases of true varicose veins of this viscus. The only symptom is profuse spontaneous bleeding. The diagnosis must be made by cystoscopic examination. When this is positive, and the hemorrhage repeated or threatening, the veins should be ligated through suprapubic cystotomy.

Paravesical Tumors.—These may be solid or cystic.

MYOMA is the only solid tumor. Belfield has observed one case, the growth springing from the muscular tunic and projecting as a nodule. Verhoogen found a myoma the size of a child's head attached to the posterior surface of the bladder by a pedicle about as thick as three fingers.

RESIDUAL CYSTS are due to proliferation of the remains of fœtal structures. Englisch has described cysts of the Wolffian and Müller's bodies, of the prostatic utricle, and of the seminal vesicles, also of the urachus.

INCLUSION CYSTS—*i.e.*, dermoids—have been already described.

There is but one example of simple cyst, contributed by Segond. The tumor was found in the muscular wall of the bladder. It was tightly adherent. Clado suggests that it may have originated from an intravesical glandular cyst.

Cysts developing in the prostatic utricle and seminal vesicles are comparatively rare. Utricular cysts are median, provided with a pedicle attached to the base of the prostate, and develop behind the bladder. Those which arise from dilatation of diverticula of the seminal vesicle are always lateral. The median cysts are due to persistence of débris in the duct of Müller.

URACHUS CYST.—Very exceptionally the urachus may remain patent throughout its course or at one end, giving rise to a cyst or fistula. The cyst will form an irregular fluctuating hypogastric tumor simulating sacculated bladder.

HYDATID CYSTS develop in the pericystic tissue. If the cyst develops in either the anterior or the posterior wall of the space of Retzius, its direction of growth will be limited by the fascia surrounding this space. It will then grow upward towards the umbilicus, but will not reach higher than this point. It may develop in the cellular tissue separating the bladder from the rectum, or it may occupy the true pelvis, in this case growing upward towards the umbilicus.

These cysts may be single or multiple, and are prone to contract adhesions to the bladder and pelvic fascia. The primitive development of the tumors is in the subperitoneal cellular tissue: hence the treatment of these cysts does not necessitate cystotomy.

A fluctuating tumor projecting into the hypogastrium should be extirpated if possible; if this is impracticable, the lining membrane should be removed and the cavity drained. A cyst filling the vesico-rectal cul-de-sac should be reached by the crescentic perineal incision described as appropriate for the removal of the seminal vesicles. It can then be enucleated, extirpated, or drained.

INTRAVESICAL URETERAL CYST has been occasionally seen, as a result of constriction at the entrance of this canal into the bladder, where the stricture occurs at the termination of the ureter on the vesical mucous membrane. In cases of such exceedingly rare conditions there are generally hydronephrosis and congenital abnormal location of the ureteral termination.

CHAPTER XIII.

DISEASES AND INJURIES OF THE URETERS.

Anatomy.—The ureters are slightly flattened, tough, white, fibromuscular canals, which conduct the urine from the kidneys to the bladder, with the investments of which their three coats are continuous. On an average they are from ten to twelve and one-half inches in length. Exceptionally they may be longer, though a greater length than fifteen inches has not been recorded. They are about one-eighth to one-sixth of an inch (three to four millimetres) in diameter, but are not of uniform calibre throughout, being slightly narrowed—(1) at a point one to one and a half inches below the kidney pelvis; (2) at the point of entrance into the bladder; (3) at the point of crossing of the iliac artery. When strictured the ureters may become enormously dilated, reaching the size of the small intestine.

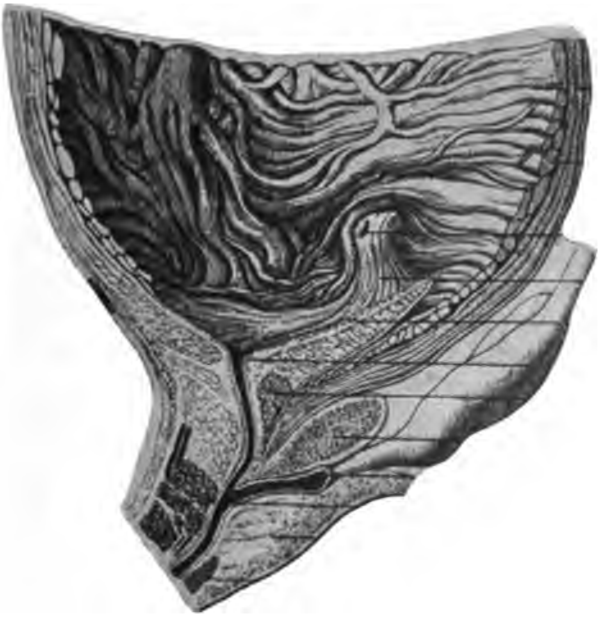
The course of the ureters is in general downward and inward. They are separated by an interval of about three inches at their upper portion and less than two inches where they enter the bladder. Their course in their abdominal portion is indicated on the surface by a vertical line passing upward from the junction of the inner and middle thirds of Poupart's ligament. The upper extremity of the ureter corresponds to a point where this line crosses the twelfth rib. The lower extremity of the abdominal portion of the ureter, corresponding to the crossing of the bifurcation of the common iliac artery, is placed slightly below the point where this vertical line intersects a line joining the two anterior superior iliac spines. (Tourneur.)

At its point of origin from the kidney pelvis the ureter lies on a plane behind that of the renal artery. It passes downward and inward, crossing the psoas muscle obliquely to the bifurcation of the common iliac artery. In its course it is slightly convex forward and inward. About the middle of its course, or a little below this point, the abdominal portion of the ureter is crossed by the spermatic artery in the male and by the ovarian vessels in the female. In front lie the cæcum and the ascending colon on the right side, the sigmoid flexure on the left side.

The pelvic portion of the ureter describes a curve with its concavity forward, inward, and upward. It passes beneath the peritoneum, along the walls of the pelvis, and, entering the posterior false *ligament* of the bladder, crossed by the vas deferens in the male, obliquely pierces the vesical coats just beneath the posterior extremity of the seminal vesicle.

In the female the pelvic portions of the ureters pass first downward, then forward and inward, in the loose cellular tissue of the pelvis. In the base of the broad ligament they lie beneath the uterine arteries, which are closely connected to them for a short distance as they pass upward to the uterus; the ureters are continued forward over the anterior vaginal vault into the bladder.

FIG. 164.



Showing the musculature of the trigone. (Young.)

The vesical portion of the ureter, about half an inch in length, runs obliquely inward and forward through the muscular layer of the bladder-walls, opening into the cavity of this viscus by a slit-like orifice. (Fig. 164.)

The muscles of the ureter are continuous with those of the bladder. Testut describes a valve-like arrangement due to absence of muscular tissue in the upper wall of the terminal extremity of the ureter. This portion of the wall is made up entirely of a fold of mucous membrane; intravesical tension at once presses this valve-like fold against the low ureteral wall, and thus effectually blocks the tube.

The relation of the ureter to the peritoneum is extremely important from a surgical stand-point. Cabot has shown that if the surgeon in stripping up the peritoneum has reached the place where it refuses to separate readily from the parietes, he will find the ureter upon the stripped-up peritoneum on the left side from half an inch to an inch outside this point; on the right side at a somewhat greater distance, owing to the ureter being displaced laterally by the interposition of the vena cava between it and the spine.

The pelvic ureter of the left side lies anterior to and to the outer side of the internal iliac artery close to the rectum; that of the right side passes downward parallel to the internal iliac artery and directly in front. As these canals descend they are covered by peritoneum to the point where this membrane is reflected upward over the posterior wall of the bladder, leaving nearly an inch, which can be incised through the vesical walls without opening the peritoneal cavity.

The mucous membrane of the ureter is continuous with that of the kidney pelvis and of the bladder, and is of the type common to the urinary tract. Glands are either rudimental or absent. The mucous surface is made up of layers of stratified squamous or transitional epithelium. Beneath these are layers of cylindrical or conical cells. The deepest layer is made up of small rounded cells.

The blood-supply is derived from branches of the renal, spermatic or ovarian, and hypogastric arteries. These vessels supply a plexus which abundantly provides for repair in case of injury. The nerves are derived from the renal, spermatic, and hypogastric plexuses.

From its strong muscular coat, it is evident that the ureter is not merely a channel, but takes an active part in conveying the secretion of the kidney into the bladder. It is well established that the unstriped muscular fibres of the ureter are in a state of intermittent peristalsis. This action goes on alternately within the two ureters, though occasionally it may be synchronous. The contractions are repeated at irregular intervals, and the quantity of urine discharged at each contraction varies greatly, probably averaging from fifteen to thirty drops.

Anomalies.—The ureter may be absent. In this case the kidney also will be absent. Bruner has collected forty-eight cases of this anomaly. It may be obliterated through a part or the whole of its course.

The ureter may be multiple; the supernumerary ureters often coalesce in some part of their course, but they may remain separate throughout. Double ureter is usually associated with a kidney which has two pelves. Nine cases of bilateral duplication are reported. (Levison.)

The ureter may pursue an errant course. This anomaly appears to be confined to females. Cases are recorded in which the ureters opened into the external urinary meatus, the vagina, and a pouch near the bladder.

Rayer reports a case in which there was congenital absence of the ureters, bladder, and kidneys; a flow of fluid having a urinous odor came from the umbilicus.

Valve-formation is an anomaly of serious import, since it leads to hydronephrosis. In place of leaving the renal pelvis by a funnel-shaped orifice at its lowest portion, the ureter may emerge from the side of this sac, often at an acute angle; or it may run for some distance in the wall of the kidney pelvis.

The operation for the relief of obstruction due to valve-formation was proposed and successfully performed by Fenger. The kidney pelvis is exposed by the lumbar extraperitoneal incision. The hydronephrotic sac is opened by a longitudinal incision, and search is made for the ureteral orifice. Should this not be found, the ureter should be incised below the sac, and a probe should be passed through this opening into the pelvis of the kidney. The valve, or the inner ureteral wall, should the obstruction be caused by the ureter running upward in the pelvic wall, is divided from above downward to the most dependent part of the sac. The resulting longitudinal wound may be closed by drawing its corners together, thus converting it into a transverse wound (Fenger), by applying numerous fine catgut sutures along the whole course of the incision (Mynter), or by turning the flaps out and sewing them to the inner wall of the sac. (Küster and Trendelenburg.)

Wounds and Rupture of the Ureters.—From the position of the ureters it is obvious that wounds of these canals, except those inflicted during the course of surgical operations, are usually attended by injuries of other organs so extensive and immediately threatening to life that the traumatism inflicted upon the ureters is of minor importance. The ureter may be wounded by direct violence, as by a stab or a bullet, or may be ruptured by indirect violence, as by a crush or a blow. In the course of abdominal section for the removal of malignant growth, division of the ureter is comparatively common.

As a result of rupture of the ureter there is extravasation of urine. Since this is sterile it does not necessarily excite cellulitis, and in case the ureter is not completely torn across the opening may cicatrize and the extravasated urine may be absorbed or become encapsulated, in the latter case producing the condition known as pseudo-hydronephrosis. If there is concomitant infection cellulitis will result, which, unless promptly recognized and treated surgically, is liable to become rapidly diffuse and terminate fatally. Following cicatrization of wounds strictures are formed causing hydronephrosis, and, finally, total destruction of the kidney.

When after a blow in the lumbar region there is passage of bloody urine with the formation of a post-peritoneal tumor which fluctuates and rapidly and progressively increases, rupture of the ureter may be suspected, and the diagnosis may be confirmed by aspiration, When, some weeks or months after injury to the ureteral region, symptoms of hydronephrosis develop, these symptoms will suggest partial laceration of the ureter followed by cicatricial contraction.

Wounds of the ureter inflicted during the course of intra-abdominal operations are usually recognized, because the white, fibrous, thick-walled canal is easily identified, and because there will probably be escape of urine into the wound.

Accidental ligation of a single ureter usually causes typical renal colic, followed, if the condition be unrelieved, by atrophy of the corresponding kidney.

Treatment.—When symptoms point to rupture of the ureter without external wound, there should be no hesitation in cutting down directly to the seat of rupture, going in behind the peritoneum, if this is practicable, draining the tissues of the extravasated urine, and restoring the continuity of the canal. When there is an external wound through which the urine escapes, this wound should be followed down to the ureter.

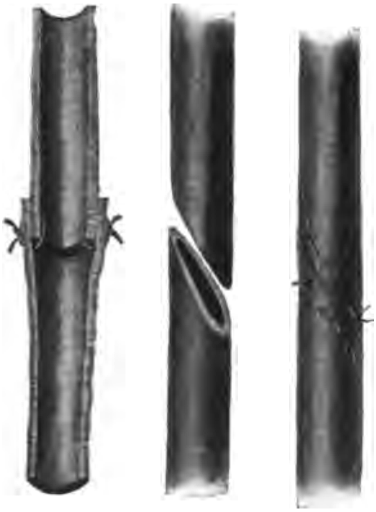
If the wound communicates with the peritoneal cavity, the incision of choice would be an abdominal one; after closure of the ureteral opening a fold of peritoneum should be brought over it on both sides and carefully sutured.

Extraperitoneal wounds, if longitudinal, do not require suture, since they heal without subsequently encroaching upon the lumen of the canal. If transverse and involving half of the lumen of the ureter, even though they be sutured and unite by first intention, there is likely to be cicatricial contraction which will ultimately cause stricture. Schopf's case, in which a transverse suture was performed, the patient perishing about two months later of tuberculosis, presented an extensive cicatrix at the seat of union. Tuffier's experiments on dogs clearly demonstrate the tendency towards stricture formation.

Transverse wounds may be treated by changing the transverse cut into one which is longitudinal. Complete division of the ureter may be treated by end-in-side (Van Hook), end-to-end, or end-in-end suture.

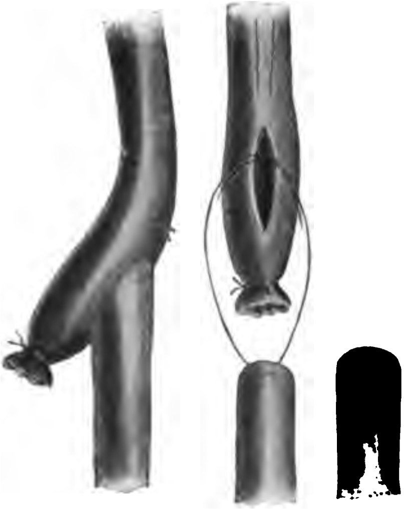
(Figs. 165–168.) From the middle of the transverse cut incisions are carried upward and downward through the ureteral walls for a sufficient distance; the four corners formed by these cross-cuts are trimmed off, and the resulting wound is united transversely by folding the ureter on itself. (Fenger.)

FIG. 165.



End-to-end anastomosis.

FIG. 166.



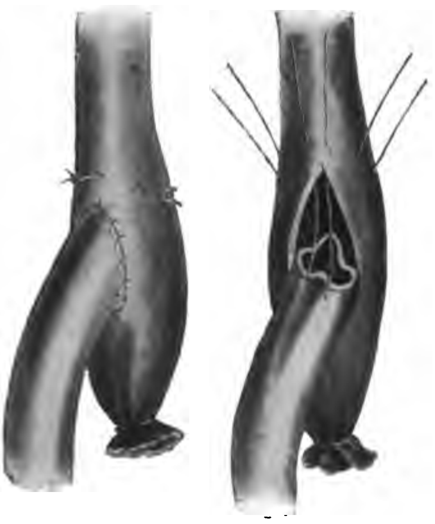
End-in-side anastomosis; first stage.

Van Hook's method of ureteral implantation is thus performed: The lower end of the ureter is ligated from one-eighth to one-fourth of an inch from its free end. With a sharp-pointed scissors a longitudinal cut is made in the lower end of the ureter, twice as long as its diameter, one-fourth of an inch below the ligature. The upper end of the ureter is split by passing a point of the scissors one-fourth of an inch within its lumen and cutting through the wall. Two very small needles, placed on each end of a sterilized catgut suture, are then passed through the wall of the upper ureteral end one-eighth of an inch from its extremity; the needle-punctures are made from one-sixteenth to one-eighth of an inch apart, and are equally distant from the end of the ureter. (Fig. 166.) The needles are then carried through the slit in the side of the lower end of the ureter and along the lumen of the canal for half an inch; at this point they are pushed through the ureteral wall side by side. (Fig. 166.) Traction upon the catgut suture will pull the upper ureteral extremity into the slit made in the lower extremity. When this has been done the ends of the loop are securely tied. (Fig. 166.) If this operation has been done through the peritoneal cavity it should be completed by covering the seat of suture by a double layer of peritoneum. The implantation may be strengthened by one or two sutures securing the wall of the proximal ureteral end to the margins of the longitudinal incision made in the distal end.

In case of dilatation of the upper end to be united, Emmet suggests puckering this end by three sutures to draw the upper end in place. (Fig. 167.)

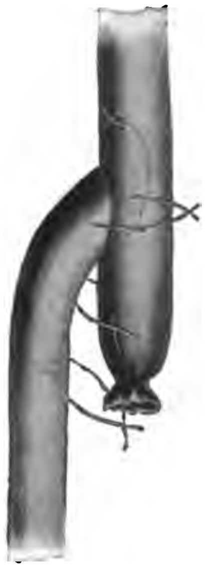
The transverse end-to-end has been done twelve times with two deaths. The end-in-end method has been employed ten times with one death. The general principle of this method is the employment of one or more traction sutures to admit and maintain the insertion of the upper into the lower segment. The end-in-side method necessitates ligation of the free end of the lower segment and implantation of the upper segment into a slit made in the side of the lower end just below the ligature, where it is held by a traction suture. The oblique end-to-end method is like the first, except that the ends are divided obliquely instead of transversely, to diminish the danger of stenosis. It requires a somewhat longer suture. This operation is recorded twice with no mortality.

FIG. 167.



End-in-side anastomosis; second stage.

FIG. 168.



End-in-side anastomosis, with reinforcing sutures.

The reported cases all give favorable results, and even hasty and faulty methods have been successful. The canal seems to be adapted to purposes of anastomosis, and this should always be attempted before sacrificing the kidney or implanting the ureter into the skin or vagina.

When the ureter is torn across, and so much of it is destroyed that lateral implantation is not possible, it should be implanted into the bladder, if this is practicable, by either the extraperitoneal or the intraperitoneal route; the latter is usually the only feasible method of performing the operation.

INTRAVESICAL IMPLANTATION.—Penrose's successful method is best performed by passing a sound through the urethra, and by means of the tip causing the wall of the emptied bladder to project at a point as near the trigone as the conditions will allow. A short antero-posterior incision is made on the point of the sound. The divided end of the ureter is then split for a short distance on each side, or incised obliquely, and is carried into the bladder for some distance, as in the end-to-side ureteral implantation, to allow one or two sutures to secure the ureter to the external bladder-wall, and, finally, a loose fold of peritoneum or omentum is fastened around the utero-vesical anastomosis. This fold, designed to prevent leakage and add strength to the junction, must not be drawn tight enough to cause constriction. The distal portion of the divided ureter should be ligated close to the bladder and removed, the cross-section above the ligature being cauterized with pure carbolic acid. Drainage is not required.

Stoeckel reports seventeen cases of implantation into the bladder with good functional results in all but one; in this, traction prevented healing.

Bover reports twenty-seven uretero-ureteral anastomoses with a mortality of seven and five-tenths per cent.; seventy-nine implantations into the bladder, thirty-seven of which were for injury during operation, with two deaths; and forty-two of which were for cure of fistulæ, with one operative death. Three have since died, two of kidney complications at a later period.

If the ureteral defect is so far removed from the bladder that neither vesical implantation nor ureteral juncture is possible, the two ends may be brought to the surface, as proposed by Rydygier, and an effort made to connect them by forming a channel of skin. Or the ureter may be implanted upon the skin surface or into the colon. Implantation into the colon is difficult, and in the light of present evidence may be expected practically always to be followed by kidney infection. Colonic implantation is attended by a heavy mortality (sixty-one per cent., Keyes), ascending infection being common even when the ureters are made to traverse the walls of the bowel obliquely and their orifices are protected by a tongue-shaped flap of mucous membrane. Hence this procedure should be reserved for cases of exstrophy, and should be performed in the manner suggested by Maydl (see page 396), which gives a mortality of a little over twenty per cent.

Ureteritis.—Inflammation of the ureters is due to infection. This extends from the bladder, as in gonorrhœa, from the kidney, as in pyonephrosis of hæmatogenous origin or tuberculosis, or from periureteric tissues, as in peritonitis or cellulitis. Congestion strongly predisposes to infection, and is caused by traumatism, pressure of tumors, distention of the ureters, lodgement or passage of calculus or clot, or the passage of irritating urine.

The lesions produced by ureteritis are similar to those observed in cystitis. In the absence of distinct glands in this part of the urinary tract, complications akin to folliculitis and periurethral abscess observed in urethritis are not likely to occur.

As a result of hyperæmia and inflammatory swelling it is apparent that the lumen of the ureters may be seriously encroached upon. If the inflammation extends beyond the mucous membrane, involving the muscular coat, there may be resulting atrophy, with loss of peristaltic power. From long-standing inflammation and the deposition of inflammatory material strictures may form.

Jaksch reports a case of membranous ureteritis in which translucent casts of the ureter were discharged from the urine.

Symptoms of ureteritis are not definite. It is nearly always associated with cystitis or pyelitis, the symptoms of which completely mask the inflammation of the ureter. Tenderness on palpation is perhaps the only symptom which would even suggest inflammation. In the urine there may be found masses of squamous epithelium without pus. (Garceau.)

Kelly states that a normal ureter can be traced and immediately examined in the upper part of the pelvic course by introducing a ureteral catheter and carrying it up to or over the brim of the pelvis. When an inflexible catheter is thus carried over the brim the ureter is displaced upward and straightened out. It can now be palpated almost as plainly through the rectum on the catheter, and any alterations in its calibre noted almost as minutely as when laid bare by dissection. The pelvic brim can also be felt per rectum.

The palpation of the ureter through the abdominal wall for the purpose of detecting tenderness is sometimes practicable, pressure being made at the intersection of the line joining the anterior superior iliac spines with one vertical to this running upward from the junction of the inner and middle thirds of Poupart's ligament. Clinical experience has shown, however, that even extreme tenderness elicited by deep pressure over this spot is not pathognomonic of ureteritis.

Treatment.—The treatment of ureteritis is that of the main disease which masks it. Instillations and irrigations such as are used in the treatment of cystitis are serviceable.

Israel, having, without benefit, performed nephrotomy for the relief of symptoms, exposed the whole ureter. This canal, though pervious, was chronically thickened and two or three times its normal size, and in places was almost cartilaginous. Nephrectomy was performed, and a cure resulted. Reynier, after removing a purulent cystic kidney by nephrectomy, noted that a purulent discharge from the ureter persisted, associated with pyrexia. He removed the whole of the ureter, thus effecting a cure.

Stricture of the Ureter.—This may be congenital or acquired. The acquired stricture may be inflammatory or traumatic. Congenital stricture has been regarded as the commonest form of narrowing. Tuffier reports twenty-nine cases. In fifteen the narrowing was in the upper part of the ureter; in the remainder it was in the lower part.

Inflammatory stricture is apparently more common than pathological records would lead us to believe, and is usually multiple. Watson has reported two cases.

Traumatic strictures are necessarily rare, since there are comparatively few cases of ureteral wound.

The symptoms of ureteral stricture are those of back pressure. Should the stricture produce complete obliteration of the ureter, the kidney will atrophy. Partial occlusion causes hydronephrosis and great dilatation of the ureter above the seat of narrowing.

The diagnosis of ureteral stricture is founded upon the development of hydronephrosis, and, in women, upon palpation and direct exploration of the ureter by means of catheters or bougies. Cystoscopic examination shows an abnormal condition of the ureteral orifice and the surrounding mucous membrane. The ureteral catheter is arrested at the seat of narrowing; when after persistent pressure it has passed through there is a continuous flow of urine. Injection of fluid, since it results in sudden increase of renal tension, causes pain, the coarctation preventing the fluid from passing into the bladder between the catheter and the ureteral walls. As the instrument is withdrawn, its tip is felt to slip from the grasp of the stricture.

Speaking of women, Kelly states that "A large percentage of cases under treatment to-day for cystitis and for irritable bladder are in reality tender, thickened ureters, and intelligent palpation will detect the tube, now hard and cord-like, bringing out the characteristic complaint of intense desire to urinate. An enlarged ureter can easily be further palpated per rectum behind the broad ligament and followed from there up over the posterior pelvic wall."

The prognosis of ureteral stricture is grave because of the usually associated renal involvement. The condition is rarely suspected till pyelitis, hydronephrosis, or pyonephrosis develop. Strictures of the lower segment are more easily cured than higher ones; those due to periureteral contracture recur even when fully dilated.

Treatment.—A permeable stricture may be treated by (1) intermittent dilatation, beginning with a bougie one millimetre in diameter and increasing to five millimetres; the treatments being practised twice a week, and being preceded by vesical irrigations and followed by ureteral irrigations of boric acid 1 to 100 or protargol 1 to 3000. (2) Continuous dilatation, the bougie being left in place for one or two days and then changed to a larger instrument until full dilatation is reached. When the stricture is not pervious from the bladder, or when it is impossible to pass an instrument into the vesical end of the ureter, the narrowing may be attacked from above. These cases are always complicated by hydronephrosis: hence it is easy to enter the pelvis of the kidney through its posterior wall. If the ureteral orifice of the pelvis cannot be found, the ureter can be exposed slightly below this point, opened by a longitudinal incision, and explored above and below by bougies ranging in size from No. 4 to No. 12 French. If the stricture is impermeable, it may be treated by longitudinal incision and transverse union of the resulting wound, or by excision and the restoration of the continuity of the ureter by uretero-ureterostomy. If none of these procedures are practicable, the ureter may be divided and implanted into the bladder or on the skin surface, or the kidney and ureter may be excised. This last operation is usually indicated in cases of unilateral tuberculous stricture.

Küster, finding obliteration of the ureter three centimetres below the pelvis of the kidney, resected three centimetres of the ureter, including the strictured portion, and fastened the distal end to the lower part of the renal pelvis. The patient was cured. Cramer has operated successfully on two cases,—one a hydronephrosis and the other a pyonephrosis,—opening into the ureter at the most dependent portion of the distended part of the pelvis. The operation of Küster is applicable only to strictures near the kidney. It would not be suitable if the ureter was permeable. In the latter case the operation of Fenger, making a longitudinal incision in the stricture and suturing in a transverse direction immediately, as in the Heinecke-Mikulicz operation for stenosis of the pylorus, is to be preferred.

If the stricture is found at a point distant from the place of incision, as when the exploration has been carried on through a wound of the kidney, Albarran advises that there should be a patient effort to pass through the stricture a "bougie armée," and then the urethrotome devised by him should be slipped over this as a guide, and internal ureterotomy follow.

After having found one stricture, the ureter should always be sounded, to determine the presence or absence of others.

Calculus of the Ureter.—The great majority of kidney-stones either remain lodged in or near the pelvis or, having once entered the ureter, pass into the bladder. This passage is often attended by no symptoms. When the stone is of such size and shape that it is arrested in its passage, thus blocking the ureter, a nephritic colic develops. Schenck and Tenney note that of one hundred and thirty-four cases of ureteral calculi seventy-four were in females and fifty-eight in males. The points of impaction correspond to the points of narrowing of the canal. (See page 504.) About one-quarter are lodged at the first point of narrowing. A few more than one-eighth are caught at the middle constriction, and over half of all ureteral calculi become impacted just above the bladder. They may lodge in the intravesical or even in the intramural portion. A single calculus is the rule, but in about one-eighth of the cases they are multiple.

Symptoms.—The prodromal symptoms of calculus in the ureter may be those of renal calculus or the passage of gravel and small concrements with the urine. Often the attack comes on without prodromal symptoms. The patient is seized suddenly with an agonizing pain radiating over the lumbar and hypochondriac regions, along the course of the ureter, to the end of the penis, to the testicle of the affected side, and to the inner surface of the thigh. The pain is usually continuous, with exacerbations. It may be felt in the belly, chest, shoulders, small of the back, or sacrum. The suffering is so severe that the patient becomes blanched, bathed in cold sweat, and sometimes collapsed. There is often reflex vomiting. The testicle of the affected side is usually drawn close up to the external ring, and the abdomen may become tender and tympanitic; if there has been no infection of the kidney pelvis, fever rarely develops. There is often a constant distressing desire to urinate, with loss of power to empty the bladder. There may be anuria due to reflex disturbance of the healthy kidney, perhaps more frequently attributable to the fact that the patient is possessed of but one secreting kidney, the duct of which is blocked.

The pain and reflex disturbances are due to retention of urine in the kidney pelvis and the upper segment of the ureter. For a time this retention may be absolute, since the irritation and congestion incident to the arrest of the stone occasion swelling and spasm which are sufficient, together with the foreign body, to close entirely the ureteral lumen. These symptoms may last a few minutes, a few hours, or one or two days, and their subsidence may be as sudden as their onset. This sudden complete subsidence indicates either retrogression of the stone into the kidney pelvis or its extrusion into the bladder-cavity. The symptoms may subside gradually, recurring at intervals, and may be followed by the gradual development of hydronephrosis. This indicates that the stone has been lodged in the ureter, and that the first absolute obstruction has yielded, partly to dilatation of the foreign body, partly to relaxation of the spasm, and has allowed a portion of the urine to pass through. Under these circumstances kidney colic is liable to recur, but with less severity.

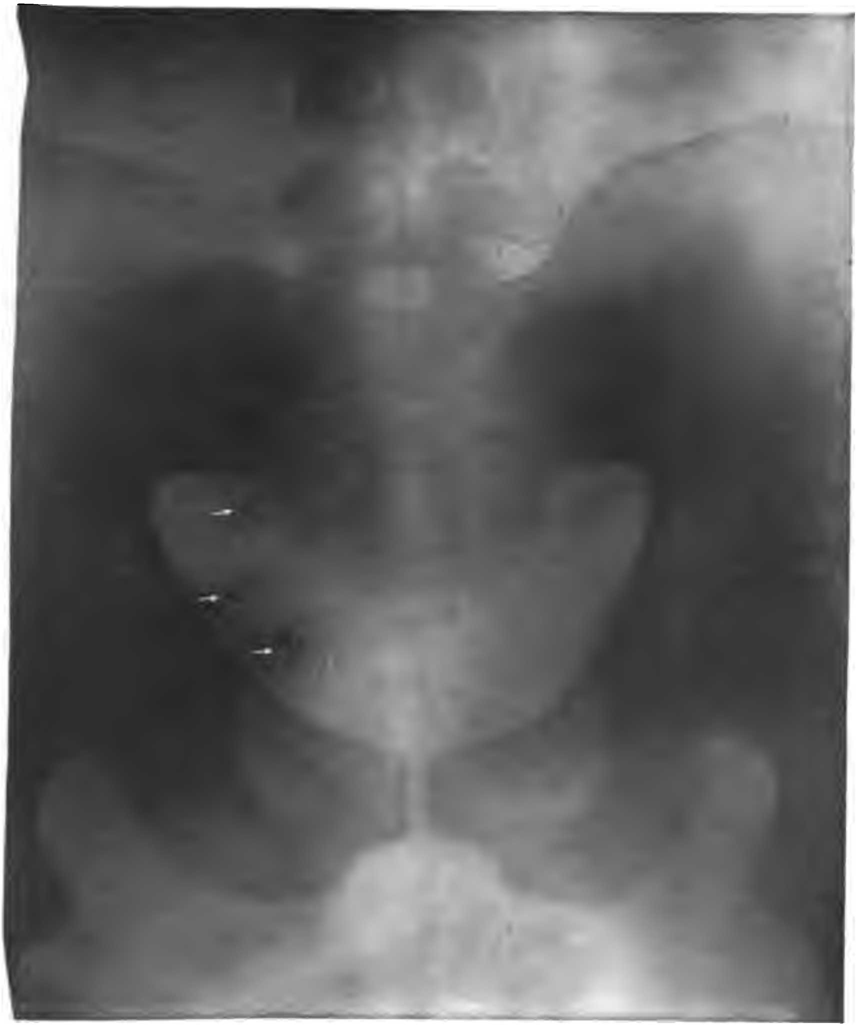
During an attack of colic the urine may be absolutely normal. This points to the existence of one healthy kidney. If blood is found, it may be taken as an evidence that the obstruction is not complete, provided there is no reason to believe that the hemorrhage comes from the kidney or the ureter of the unaffected side. Immediately on the subsidence of the attack a small quantity of blood is constantly found in the urine.

Diagnosis.—The diagnosis of impacted ureteral stone is based on a history of the symptoms of kidney calculus (see page 554) and of one or more attacks of colic, followed by the development of hydronephrosis or pyonephrosis. When typical symptoms develop, the X-ray will often demonstrate both the seat and the number of ureteral calculi. When the shadows are not placed along the normal course of the ureters, the presence of phleboliths or calcareous glands should be suspected.

Pain may be referred to the healthy kidney. Neuman has reported three cases of this crossed renal pain, in two of which calculi and in one pyonephrosis were found on the side opposite that which gave the subjective symptoms.

Palpation either through the rectum or through the abdominal walls, and ureteral catheterization when possible, may enable the surgeon to form a positive opinion as to the presence of ureteral calculus; but it must be confessed that often all diagnostic means fail. Thus, a clear history may be wanting, the patient perhaps having

FIG. 169.



Multiple calculi in the ureter. (Skiagraph made by Dr. H. K Pancoast.)

severe abdominal pain, which is attributed possibly to gall-stones or to some other intra-abdominal trouble. If the stone completely blocks the ureter, in place of hydronephrosis the kidney may atrophy exactly as it would do if a ligature were applied about the ureter. In fat subjects it is extremely difficult to develop a satisfactory skiagraph.

Diagnosis founded on kidney colic is usually fairly reliable, since this pain is highly characteristic. Yet it must be remembered that stone in the ureter has been diagnosed when the real condition was passage of a gall-stone, appendicitis, neuritis of the lumbar nerves, spinal caries, or acute intestinal obstruction.

A careful examination of the urine will enable the surgeon to determine whether or not the symptoms are due to blocking of the ureter. Moreover, the conditions with which ureteral calculus may be confounded have usually certain pathognomonic features which sooner or later manifest themselves. Thus, gall-stone is attended with jaundice, and the pain is likely to be referred to the region of the right shoulder. Appendicitis exhibits increasing tenderness on pressure over McBurney's point, the abdominal symptoms become rapidly and progressively worse, and blood and pus are not found in the urine. In neuritis of the lumbar nerves the tenderness is superficial, and there is no marked change either in the quantity of urine passed or in its constituents. The persistent vomiting of intestinal obstruction, shortly becoming fæcal, and the obstinate constipation, would suggest the nature of the affection.

The symptoms are due to obstruction, and not to the irritation caused by the rough corners of a stone, and they will be as distinctly marked if the obstruction is due to a portion of tumor, a blood-clot, or a mass of inspissated tubercular pus. The diagnosis as to the cause of the obstruction is dependent on the previous history of the patient.

Intermittent pyuria—that is, the passage of normal urine during attacks of colic, the passage of pus in the urine during intervals—points to the existence of one healthy kidney. The blocking during the acute attacks is complete, hence no pus escapes into the bladder; during the intervals, owing to relaxation of spasm or lessened congestion, part of the urine escapes on the diseased side, carrying with it pus.

Palpation will fail certainly in a large majority of cases. It may, however, show a point of tenderness, which if constant is a sign of some value in locating the stone. If the calculus is lodged near the vesical orifice of the ureter, it may readily be felt in women. In men this is more difficult, since the examining finger per rectum can rarely be extended as far as the posterior extremity of the seminal vesicles. Ureteral catheterization may sometimes succeed in locating the seat of obstruction, and may possibly indicate the presence of stone. As a further means of diagnosis, and one always justifiable when the integrity of the kidney-substance is threatened by the persistence of symptoms, exploration by lumbar incision is valuable. This enables the surgeon to explore directly the entire abdominal ureter, and by means of bougies to determine whether or not the pelvic portion is patulous.

The diagnosis between kidney calculus and blocking of the ureter from unnatural mobility of the kidney is sometimes absolutely impossible. The symptoms are precisely the same, and in both cases the urine may show blood after the attack is over. A movable kidney would be suggested by the prompt relief which sometimes follows either abdominal manipulation of the organ or the assumption of the dorsal decubitus.

Prognosis.—The calculus having passed into the ureter may recede into the kidney pelvis, may pass on to the bladder, or may be permanently lodged.

Calculus lodged in the ureter, if it entirely blocks this canal, causes rapid and complete destruction of the secreting substance of the kidney. Provided the other kidney is healthy, it is usually able to function for both. When the obstruction is partial there is back pressure, with more or less dilatation of the ureter, kidney pelvis, and calices, and gradual degeneration of the kidney-substance. The congestion incident to this condition strongly predisposes to infection. As the ureteral walls dilate they commonly become thickened.

The calculus may ulcerate entirely through the ureteral wall, forming an abscess, which may open externally in the lumbar region, or into the colon, or may follow the course of perinephritic abscesses.

Treatment.—Since most stones which enter the ureter from the kidney pelvis pass into the bladder, the early treatment of either a first agonizing attack of renal colic incident to calculous obstruction of the ureter, or of recurrent mild attacks should be palliative. The patient should be given a hot bath, and a full dose of morphine hypodermically. The administration of medicines by the mouth is of little service, since there is usually vomiting. A hot rectal enema is useful in relieving the tympany, which is sometimes symptomatic of ureteral obstruction. When the pain is so agonizing that it seriously affects the pulse, inhalations of ether should be given until sufficient time has elapsed for the morphine to produce its quieting effect. The urgent desire to micturate, from which patients suffering from kidney colic complain, is a pure reflex. There is usually retention, probably spasmodic in nature. It is relieved by a hot sitz-bath, the patient being directed to urinate while sitting in the bath. If it should persist, the bladder forming a distinct tumor above the pubis, the catheter should be used, but only by a surgeon thoroughly skilled in the details of genito-urinary asepsis, since the conditions for ascending infection are peculiarly favorable after the passage of a stone.

When it is evident, from the gradual development of a hydronephrosis or the persistently recurring mild attacks of kidney colic, that a calculus is lodged, and that the kidney is becoming seriously affected; when during an acute attack the secretion of the urine is partly or completely suppressed, suggesting that the patient has not a healthy kidney on which to fall back; or when fever and hectic develop, together with pus in the urine, pointing to pyonephrosis,—surgical interference is imperative.

Calculi lodged in the vesical orifice of the urethra and projecting into the bladder have been removed by the lithotrite or through a vesical opening. In women calculi frequently lodge in the portion of the ureter lying within the folds of the broad ligament, because of narrowing incident to disease of this structure. An incision through the anterior vaginal vault upon such a stone, if it be palpable, enables the surgeon to remove it without opening either the peritoneum or the bladder.

Usually the safe removal of a ureteral calculus requires the ilio-lumbar incision. This cut begins just below the twelfth rib at the outer border of the sacro-lumbar muscles, and is carried downward and forward to the middle of Poupart's ligament, passing about an inch above and to the inner side of the anterior superior spine at the ileum. Through it the kidney and the entire ureter are accessible.

The incision is deepened till the peritoneum is exposed throughout the entire length of the wound; this membrane is then stripped by the finger from the iliac and psoas muscles till the iliac vessels are exposed. It must be remembered that the ureter strips up with the peritoneum, and that this canal may be extremely difficult to recognize when it is dilated and has formed adhesions as a result of periureteritis. When a stone is present and readily accessible, this forms a landmark which makes the operation a comparatively easy one; but when the calculus lies deep in the pelvis, the operator may experience considerable difficulty in identifying the ureter as a preliminary to following it in its downward course. This identification may be facilitated by bearing in mind the anatomical relation of the ureter, remembering that it is found lying in contact with the posterior surface of the peritoneum one-half inch to one inch external to its point of mesenteric reflection, just in front of the bifurcation of the common iliac artery.

Young has shown that the ureter may be followed down to its point of entrance into the bladder. This is accomplished by freeing it at the brim of the pelvis, making gentle traction upon it, drawing aside with broad retractors the vesical wall near the peritoneum, and following the ureter by a blunt dissection into the depths of the pelvis. The calculus, if present, may be palpated, and may usually be pushed up into a portion of the ureter so accessible as to allow of the introduction of sutures. It is customary to apply Lembert sutures before the ureteral incision is made. This is not desirable, since the cut surfaces should be brought directly in contact rather than inverted. When it is impossible to push the calculus up, it may be dislodged by means of long, fine forceps passed through an incision so placed in the dilated portion of the ureter that sutures can be subsequently introduced. After removal of the calculus, the ureter should be explored to demonstrate the absence of either calculi or stricture interfering with the free flow of urine into the bladder. It is customary to drain these wounds; where, however, the urine is sterile and the operation does not require much handling of tissue, they should be closed without drainage. To insure against subsequent weakness of the abdominal walls, the large muscular wound should be very accurately closed by broad mattress sutures of chromicized catgut.

For the removal of calculi lodged in the upper portion of the ureter, the parietal incision need be prolonged no further than to a point an inch above the anterior superior iliac spine. If it is possible to push the calculus back into the renal pelvis, Albarran advises its removal through a nephrotomy wound.

Calculi lodged in the pelvic portion of the ureter can be reached through the lower half of the ilio-lumbar incision or through a vesical cut carried from the insertion of the rectus muscle four inches upward (Witherspoon). The muscle is torn through in the direction of the fibres and the fascia is cut, exposing the peritoneum which is stripped up from the abdominal wall as far as the ilio-pectineal line. The finger is then passed to the vesical base, pushing upward and inward the lateral false ligament of the bladder, and separating the peritoneum from the pelvic wall as far back as the vas deferens; by following this canal for two inches from its point of crossing the obturator vessels, the ureter will be reached passing behind it. Both these canals strip up with the peritoneum, and the ureter may be palpated as far as the brim of the pelvis. The operation is bloodless and leaves a strong abdominal wall.

Before closing the wound, the ureter must be catheterized to ascertain if any other calculi are present, or if there is any narrowing of its lumen. The exploratory catheterization of the ureter is at times difficult; exceptionally, an instrument cannot be passed from above downward. In these cases Albarran advises catheterization from below upward by the endoscope, or, if necessary, by suprapubic cystotomy.

The mortality of uretero-lithotomy when uncomplicated by anuria, pyelitis, or pyelonephrosis is less than six per cent.

Fistula of the Ureter.—Fistulæ are secondary to wounds, rupture, or ulceration of the ureters. A longitudinal wound may heal spontaneously without the formation of either fistula or stricture; transverse wounds involving half the diameter of the ureter, and particularly when they completely sever it, are followed by fistulæ.

These wounds are usually inflicted during the course of gynæcological operations. Spontaneous fistula—*i.e.*, that due to ulceration—is caused by tubercular infiltration, malignant growth, calculus, or foreign body; the fistula under such conditions is secondary to partial or complete ureteral obliteration.

A fistula may open on the surface of the body or into the cavity of a neighboring viscus. The surface opening is commonly in the lumbar region; it may be found in the groin or in some portion of the anterior abdominal parietes. Visceral opening is commonly into the uterus or vagina, but may be into the rectum, and very exceptionally into the stomach. The patulous tract is apt to be fairly direct; it may be long and irregular.

Symptoms.—The pathognomonic symptom of ureteral fistula is a continuous or intermittent discharge of urine. Duplay and Reclus state that if the fistula is near the kidney the flow of urine is continuous. If it is low down towards the vesical extremity the flow is intermittent, coming in jets. The urine may remain perfectly clear, showing no admixture of pus or kidney albumen. For diagnostic purposes methylene blue may be given by the mouth.

Diagnosis.—The diagnosis between ureteral and vesical fistulæ can be established by injecting colored fluids into the bladder. Renal fistulæ are fairly direct, and but a slight amount of urine escapes from them if the ureter is pervious. Catheterization of the ureter and injection of colored fluid will sometimes be serviceable in establishing a diagnosis.

Prognosis.—There is little tendency towards spontaneous cure of ureteral fistula. Provided narrowing of the orifice does not take place, the fistula may produce no appreciable effect upon the general health. It often happens that, because of gradual cicatricial formation and encroachment upon the ureteral calibre, hydronephrosis develops. It should be remembered that in case the ureter is entirely divided, the lower extremity becomes atrophic from disuse, thus making an operation for the restoration of the continuity of the channel extremely difficult.

Treatment.—The first requisite of successful treatment is that the ureter shall be restored to its normal calibre. It is possible that this may be accomplished by the use of ureteral bougies or continuous ureteral catheterization practised through the bladder. Usually the ureter is impervious.

When the fistula opens into the vagina, colpocleisis may be performed. This operation, first practised by Hahn, converts a part of the vagina into an artificial reservoir for the urine. Kelly in one case of uretero-vaginal fistula closed the ureter by suture. When the vesical extremity of the canal is obliterated the ureter may be implanted into the bladder by the intraperitoneal or the extraperitoneal route.

When the fistula involves the abdominal portion of the ureter, direct closure, splitting of the ureter and transverse suture, or excision of the diseased area, followed by ureterostomy, may be indicated. When it is placed high in the ureter, it may be resected, together with a segment of the ureter, and this canal may be sutured to the renal pelvis.

Cure may be accomplished by nephrectomy. This operation has been many times successfully performed. It should, however, be left as a last resort, efforts being made either to restore the continuity of the ureter or to implant it into the bladder.

Tuberculosis of the Ureter.—Tubercular involvement of the ureter is usually secondary to tubercular disease of the bladder or the kidney. The infiltration attacking a portion of the ureter and partially or completely obliterating it may produce dilatation of the segment above, and hydronephrosis or pyonephrosis; or the entire ureter may be infiltrated, becoming a dense, often nodular, impervious cord.

The symptoms of tubercular infiltration of the ureter are usually completely masked by those of vesical or renal disease. In women palpation of the lower extremity of the ureter through the vaginal vault might show characteristic induration and nodulation. In both sexes attempts at ureteral catheterization would demonstrate points of narrowing.

The treatment of ureteral tuberculosis cannot be formulated, since this is never encountered clinically as an isolated lesion. If in the course of a nephrectomy for tubercular kidney the ureter is found involved, it should be removed with the kidney.

Tumors of the Ureter.—Tumors of the ureter have been reported in a few instances, this canal having been secondarily involved by malignant growth, extending from either the kidney pelvis or the bladder. Albarran collected thirty-two such cases. Target found a large round-celled sarcoma, involving the whole length of the right ureter, and Chrobak reports a subserous myoma.

The diagnosis of these rare tumors is scarcely possible. The symptoms are those of ureteral obstruction and hæmaturia. Bloody non-purulent urine containing masses of squamous epithelial cells following ureteral catheterization in a patient over fifty would be suggestive of ureteral neoplasm. (Albarran.) The ureteral papillæ are the most frequent seats of ureteral cancer. The disease here may be recognized by the cystoscope. The treatment indicated is complete nephro-ureterectomy. Of thirteen such operations there were three deaths and one known recurrence.

Prolapse of the ureter has been reported by Caile in a child two weeks old. There are nineteen recorded cases, two of whom were operated on, with one death. (Young.) A sac which was supposed to be a vesical diverticulum presented at the urethral orifice. It was found to be a prolapsed ureter dragged down by a papillomatous growth.

Two cases of URETERAL CYST caused by psorosperms have been reported, one by Eve; the only symptom was profuse hæmaturia, which was not attributed to the cystic formation.

CHAPTER XIV.

INJURIES AND DISEASES OF THE KIDNEYS.

Surgical Anatomy.—The kidneys are situated in the hypochondriac region on either side of the vertebral column behind the peritoneum. (Fig. 170.) The right kidney is a little lower than the left (three-quarters of an inch), probably because of the superimposed liver. The left kidney extends from the level of the interval between the eleventh and twelfth ribs, near the spine, to the level of the third lumbar spine. Each organ is inclined forward and inward, so that their upper portions converge. The outer border faces upward and backward, the inner downward and forward.

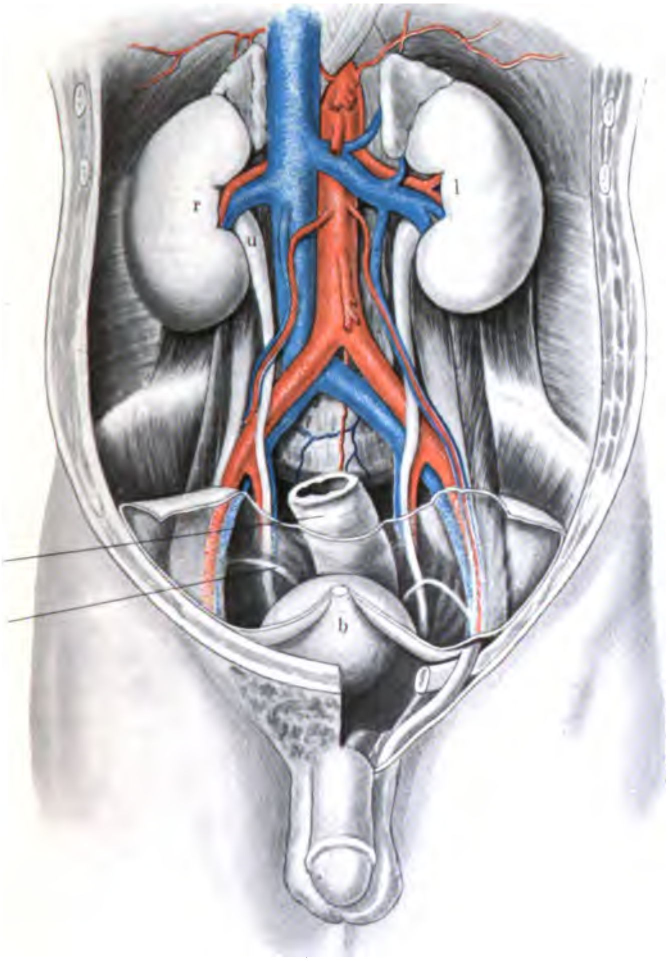
The kidneys are fixed in position by a series of short blood-vessels, the parietal peritoneum, the pressure of the abdominal viscera, and a fibro-lipomatous sheath called the renal fascia. This fascia is formed by a splitting of the subperitoneal connective tissue, enclosing the kidney in a pocket and passing inward as a single layer to cover the great blood-vessels. During fœtal life this investment is purely fibrous; later there is an abundant deposit of fat, to which the name of fatty capsule has been given. The deposit of fat is most marked on the outer borders and posterior surfaces of the kidneys. It may be one or two inches in thickness, and serves to fix the organs in a soft nidus.

The kidney of average size is four and a half inches long, two and a half inches broad, and one and a half inches thick. It weighs about four and a half ounces. The kidney of a woman is about half an ounce lighter.

It is irregularly oval in shape, with a convex outer border and a concave inner border. It is ordinarily of brownish-red color, but this is subject to marked variations, depending upon the degree of congestion or the presence of degenerations. It is fairly firm in consistence. The anterior surface of the kidney, turned forward and slightly outward, is covered by peritoneum in its upper portion. The upper extremities of both kidneys are capped by the suprarenal bodies.

The liver lies in front of the upper two-thirds of the right kidney, and is often attached to it by a peritoneal fold called the hepato-

FIG. 170.



Position and relation of the kidneys and other retroperitoneal structures.

renal ligament. Its lower third is in relation with the ascending colon, which lies in direct contact with it, the beginning of the transverse colon, and the second portion of the duodenum, which descends vertically along the inner portion of the anterior surface, crossing the renal vessels and their bifurcations at a right angle. The inferior vena cava obliquely crosses the extreme upper portion of the right kidney. (Testut.)

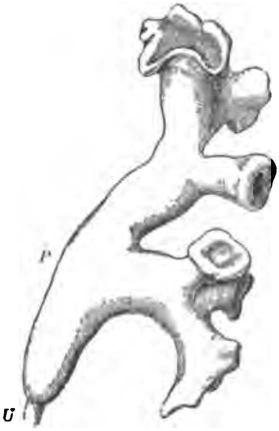
The anterior surface of the left kidney is in relation with the tail of the pancreas, which rests upon its upper fourth, with the spleen lying above and externally, and the stomach below. The terminal portion of the transverse colon and the upper portion of the descending colon lie directly in contact with its lower half or two-thirds, connected to it by loose areolar tissue, unless there be a distinct mesocolon.

The comparatively flat posterior kidney surface faces backward and inward. Behind it lie the diaphragm, the quadratus lumborum muscle, from which it is separated by the anterior layer of the lumbar fascia, and the intercostal and lumbar nerves, and to the inner side the psoas muscle. Externally it extends beyond the quadratus lumborum muscle, and is then in relation with the transversalis. The posterior kidney surface is entirely free from peritoneal investment, except in the anomalous condition characterized by the presence of a mesonephron.

The diaphragm immediately behind the upper posterior surface of the kidney is extremely thin, and presents a triangular opening, allowing the kidney to lie in almost immediate contact with the pleura. This opening explains the frequency with which abscesses burrow into the pleura. The outer convex border of the kidney is in relation with the spleen and descending colon on the left side, the liver on the right side. The inner concave border, resting on the psoas muscles, presents a fissure termed the hilum, into which pass the blood-vessels and ureters; it is about two inches from the median line, and is about one and a half inches in depth. The important structures coming off from it are the veins, placed anteriorly, the arteries, behind the veins, and the pelves and ureters, posteriorly. The renal arteries and veins are on a level with the space between the spines of the first and second lumbar vertebræ. The hilum extends to a considerable depth within the substance of the kidney, forming a central cavity known as the sinus.

The kidney is enclosed in a proper capsule of fibrous tissue, beneath which lies an investment of unstriped muscles. The solid part of the organ is composed of the cortical layer, containing the Malpighian glomeruli, which are the beginnings of the uriniferous tubules, and the medullary layer, containing the straight and spiral portions of the uriniferous tubules, as well as the collecting tubules. These collecting tubules are arranged in separate pyramidal masses, the pyramids of Malpighi, the apices of which form papillæ projecting into the sinus. (Fig. 184.) They are separated from each other by the cortical substance, which envelops them on all sides, except in the region of the papillæ. The papillæ project into the calices or infundibula, which are the small diverticula into which the ureter subdivides. When the ureter reaches the sinus, having passed in by the hilum, it dilates into a funnel-shaped sac, called the pelvis. From this sac pass a few major channels, each of which divides into several smaller ones, the calices, these in turn terminating about the openings of the papillæ. (Fig. 171.) Usually the calices are as numerous as the papillæ; sometimes two papillæ open into a single tubule. The number of calices is usually from eight to twelve. Each is about two-fifths of an inch long, and is in calibre No. 6 to No. 10 F. Several of these small canals unite to form a series of three or four larger canals, which open into the pelves of the kidney. (Fig. 171.) There are usually three of these large branchings of the pelves,—an upper, a median, and a lower. They vary greatly in length and calibre. The pelvis, which receives the urine from the calices, is about an inch high and not quite an inch wide, and runs directly into the ureter. (Fig. 171.) Sometimes the junction of these two channels is marked by a slight constriction. The pelvis is placed within the sinus, but extends upward beyond the limits of this opening. In front of it lie the vessels; behind it lies the posterior renal artery, when this vessel is present. The portions which extend beyond the kidney have the peritoneum and the fatty capsule in front, the psoas muscle posteriorly. The duodenum is in relation with the anterior surface of the right pelvis.

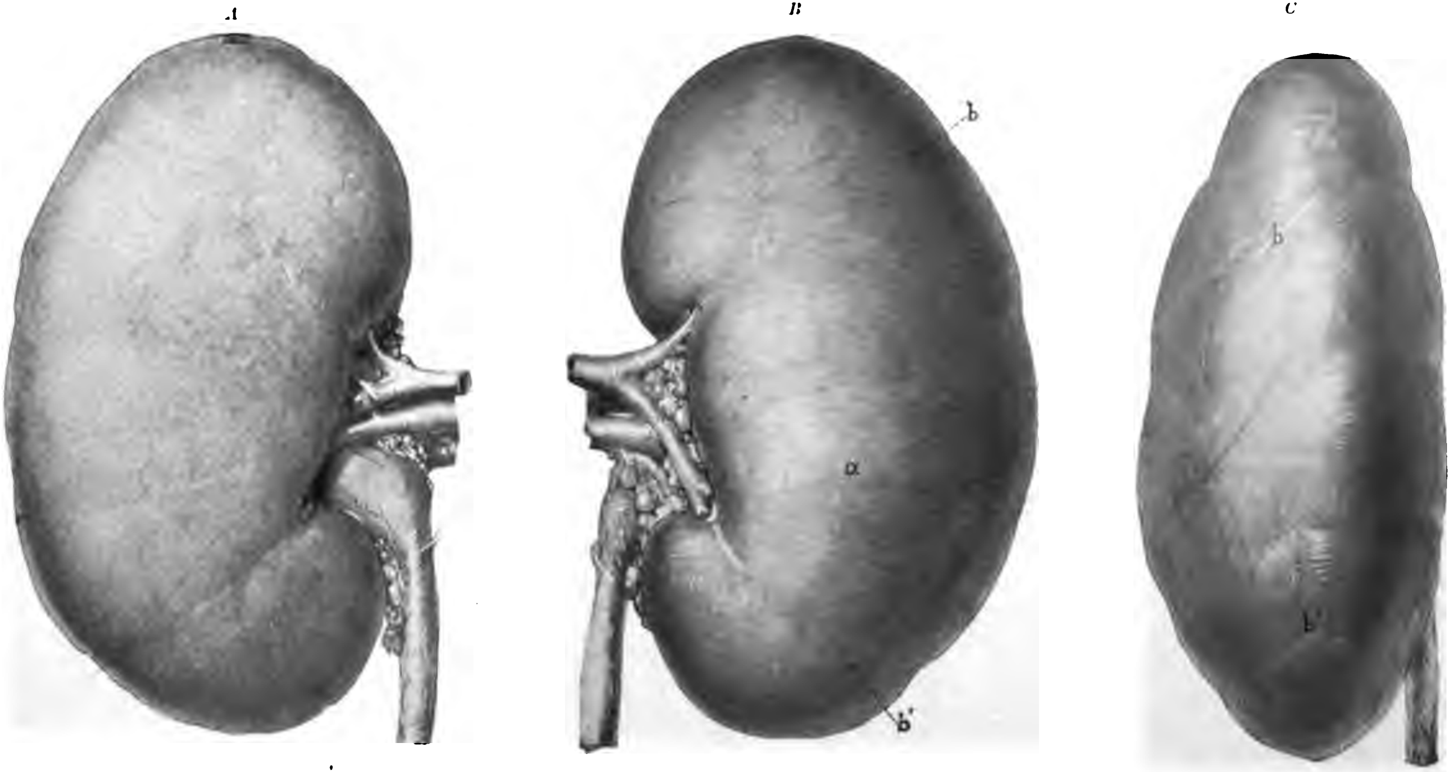
FIG. 171.



Renal pelvis dissected from the pyramids. *P*, pelvis; *U*, ureter. (Henle.)

The arteries of the kidneys divide into four or five branches, which enter the hilum and lie between the renal vein and the ureter. Within the sinus the branches of the artery run beside the calices (infundibula) and are embedded in fat. The right renal artery is slightly longer than the left, as it has to cross the vertebral column;

Fig. 172.



Normal kidney *A*. Posterior view. *B*. Anterior view. *C*. Lateral view. *b-b'*. Brödel's white line. (Brödel.)

for a similar reason the left renal vein is longer than the right. The renal veins leave the kidneys at the hilum, and, passing in front of the renal arteries, empty into the vena cava; the spermatic vein joins the renal vein on the left side.

The blood-supply to the kidneys is particularly abundant. The renal artery may pass as a single vessel to the hilum, or may divide into several branches before reaching this point. These branches are named, according to their distribution, superior, middle, and inferior. The posterior branch passes downward and backward to enter the hilum behind the pelvis.

The veins are proportionally as numerous and large as the arteries. In the sinus there are a number of branches, usually lying in front of the arteries; these fuse into the renal vein. This is a short, valveless trunk passing to the vena cava. The perinephric veins are large and numerous and communicate with the blood-vessels of the kidney.

The lymphatics pass to the glands of the lumbar plexus lying near the hilum. The nerves are abundant and supplied with ganglia; they come from the sympathetic system. In the stroma of the kidney are found muscular fibres, especially about the papillæ.

Brödel has demonstrated that about two-thirds of all kidneys are vascularized by two distinct vascular systems, the vessels as they enter being separated from each other at the renal pelvis. The major vascular tree occupies about three-fifths of the kidney, usually its anterior portion, and the remaining posterior two-fifths is vascularized by the minor system. Normally these two vascular systems are separated in the kidney by a distance of about two millimetres. Upon distention of the pelvis and calyces, however, this separation may be increased to two centimetres or more. At the plane of separation no large vessels are found and none cross. Upon careful examination the surface of the kidney is seen to be made up of a number of irregular areas about the size of the end of the thumb. These areas represent the bases of the renal pyramids. They are surrounded by pale lines representing the columns of Bertini extending up between the pyramids and forming support for the blood-vessels. Sometimes these pale lines are not seen, but in their place may be distinguished groups of stellate vessels. These small white lines unite a little anteriorly to the convex border of the kidney into a longitudinal slightly depressed white line, appropriately called Brödel's line, which represents the line of division between the anterior and posterior rows of pyramids, the connective tissue of which carries the largest blood-vessels. (Fig. 172.) At a distance of about one centimetre away from this white line, and located in that portion of the kidney corresponding to the surface, which, as determined by palpation at the renal hilum, contains the lesser number of vessels (usually the posterior half), is located the *least* vascular portion of the organ. This avascular plane is always parallel, however, with Brödel's white line.

Anomalies of the Kidney.—The kidneys may vary from normal in number, size, shape, position, attachment, and mobility.

There may be more than two kidneys, or there may be congenital absence of one kidney. This latter has been noticed sufficiently often to warrant the suggestion that the surgeon, before performing nephrectomy, should make sure of the presence of two kidneys.

Roberts collected twenty-nine cases of solitary kidney, twenty-two of which occurred in males and six in females. The sex was not given in one case. In sixteen cases the left kidney was absent, in thirteen the right.

Ballowitz has made an extensive collection of cases of congenital absence of one kidney. He found that the deficiency was more common on the left than on the right side, and that the single kidney was usually normal in position and shape, but enlarged. A single kidney has sometimes a double vascular supply and two ureters, though showing no other signs of fusion. Morris states that congenital absence of one kidney can be expected once in every three thousand nine hundred and ninety-two and two-fifths cases.

The kidney may be congenitally enlarged ; this condition is usually associated with atrophy, or possibly with absence, of the other kidney, and is compensatory. A single large kidney seems to be perfectly competent to carry on the functions of both organs, since there are many autopsies recorded showing that the bearers of this malformation have lived to an advanced age and perished of other diseases. Thus, Conder reports one such case, the patient dying at the age of seventy-two.

Variations in shape may be due to overgrowth or malformation of neighboring organs or structures. Usually these are true growth-perversions, and they may assume a great variety of forms.

The upper extremities of the kidney may be joined by a bridge over the abdominal aorta and inferior vena cava, the organ assuming a horseshoe shape ; this connection may consist of true kidney structure or may be merely a band of connective tissue. It may closely simulate tumor of the stomach. The kidneys may be fused along their whole inner surface, forming one large oval or rounded organ, with blood-vessels and excretory ducts attached to its centre or possibly to one side. Fusion usually results in apparently one large kidney, or in the sigmoid or horseshoe kidney above described. Morris states that there is one horseshoe kidney in every sixteen hundred examinations. Fusion may present certain bizarre forms, as in a case reported by Gruber, in which one kidney was superimposed upon the other, the long axes of the organ lying at right angles to each other, and both being displaced from their normal position. The kidney may also be found extremely lobulated. This condition is normal in the fœtus. When it persists it is due to arrested development. Double ureter and multiple arteries and veins are often noted. Fused kidneys sometimes reach enormous sizes.

The position of the kidney may vary from the normal in practically any direction except posteriorly. The kidney may lie too high, but this is extremely rare. It is often found over the sacro-iliac articulation, and has been so widely displaced that it has been found in the canal of Nuck. Both kidneys may lie to one side of the vertebral column, either about their normal position or in the pelvis. The kidney may be tilted, rotated, or turned on its long axis. The hilum may look forward, outward, downward, upward, or backward; this malposition may be associated with fusion.

The attachment of the kidney is necessarily anomalous when it is fixed in a faulty position.

The anomalies of mobility are of sufficient surgical importance to receive special consideration. The other growth-perversions usually excite no symptoms, and are of importance to the surgeon principally because they may cause errors in diagnosis and treatment. Thus, a malformed abnormally placed kidney first discovered during the course of abdominal palpation for the detection of the cause of obscure gastro-intestinal troubles might readily lead to serious error; the removal of a diseased kidney would necessarily be fatal should this happen to be an instance of solitary kidney; an attempted nephrectomy on a fused kidney would result disastrously. When the kidney is fixed in a faulty position it usually gives rise to no symptoms. Morgagni, however, states that aortic aneurism was caused by the pressure of horseshoe kidney, and Neufville records the case of a woman, twenty-five years old, previously free from symptoms, who in consequence of the sudden congestion of a horseshoe kidney developed thrombosis of the large veins, which was followed by death.

The only operation practicable for the relief of symptoms due to a kidney congenitally fixed in a faulty position is nephrectomy.

Floating kidney is a congenital anomaly in the attachment of the organ. The floating kidney is completely enveloped in a fold of the peritoneum, and is loosely attached to the posterior abdominal wall by a mesonephron: hence it lies within the peritoneal cavity. The condition is extremely rare.

A differential diagnosis between floating and movable kidney cannot be made, since the range of motion is sometimes greater in the latter condition than in the former.

Movable kidney is seven times as frequent in women as in men. The causes of unnatural mobility are such as lessen the intra-abdominal pressure, or mechanically press or pull the kidney from its normal recess. Intra-abdominal pressure is lessened suddenly by pregnancy, more gradually by emaciation and weakness of the abdominal muscles. The kidney is thrust or dragged from the paravertebral space by strain or traumatism, lateral curvature of the spine, the action of gravity, particularly in cases of pathological enlargement, as in hydronephrosis and calculus, constriction of the lower ribs, as in the case of tight lacing, and the weight of overlying or attached organs, such as the liver or the hollow viscera. In about twenty per cent. of cases both kidneys are abnormally movable. The left kidney alone is rarely affected. The greater frequency with which the right kidney is involved (eighty per cent.) is explained by its relation to the liver and the greater length of its artery.

Pathology.—The vessels and fascia are elongated and thinned, the ureter often partially twisted or kinked, and the renal pelvis shows dilatation from recurring attacks of hydronephrosis. The kidney may be slightly enlarged from passive congestion, or may present distinct evidence of degeneration from retention. Perirenal and periureteral adhesions may form from the same cause. The peritoneum over the kidney is lax, the duodenum may be elongated, and the gall-bladder may show the signs of biliary retention secondary to traction on the common duct. In long-continued cases there may be found the phenomena of chronic gastro-intestinal catarrh often associated with general splanchnoptosis.

Symptoms.—Aside from the detection of the tumor by palpation, the cardinal symptom is pain, usually referred to the lumbar region. This may amount to simply a dragging and wearing sensation, made worse by exertion and relieved by rest; or it may be paroxysmal, agonizing in type, exactly resembling the attacks of renal colic caused by blocking of the ureter and sudden tension. These paroxysms recur at irregular periods, are rather sudden in onset, and often follow fatigue or active exertion. Frequently associated with this pain are distinct gastro-intestinal symptoms. If the right kidney is unduly movable, it may partially block the bile-duct and the duodenum, either by direct pressure or by dragging, thus causing hepatic colic, dilatation of the stomach, and symptoms of gastric catarrh. When the left kidney is movable, the same partial blocking or dragging may affect the stomach or the transverse and the descending colon, thus interfering with intestinal digestion.

The renal colic may be referred to the lower part of the abdomen and radiate into the groin and down the thigh. Shortly there develop great tenderness over the kidney both in front and behind, and abdominal distention and tenderness to such an extent as to make renal palpation difficult. This condition may persist for days, but usually subsides in a few hours.

The urine is usually scanty and contains blood. Hypersecretion is an early sign of relief of tension. When fever develops, the diagnosis may be exceedingly difficult.

Neurasthenia is commonly associated with nephroptosis, as are flatulence, constipation, and other signs of gastro-intestinal catarrh, possibly reflex in origin, probably due to general visceroptosis. By pressure against the vena cava and particularly against the ovarian vein there may be kept up a passive congestion of the pelvic organs, causing menstrual disturbances and predisposing to chronic inflammation. (Goelet.)

Morris calls attention to the fact that movable kidney and large gall-bladder are each more frequently met with in women than in men, and often occur in the same person. The association of the two states is explained by the custom of wearing corsets. While the downward pressure of the liver induces mobility of the kidney, the mobility of the kidney in turn acts upon the gall-bladder and causes distention by dragging upon the duodenum and the bile-ducts, thus obstructing the passage of the bile. The same mechanism explains the frequency with which gastric dilatation and symptoms of gastro-intestinal catarrh are associated with movable kidney.

Diagnosis.—This is based on the history of a sufficient cause for undue mobility, and of continuous or paroxysmal pain, often with profuse urination following the paroxysms, on associated symptoms of gastro-intestinal derangement, and on the finding of a movable tumor by abdominal palpation. If a tumor lying in the hypochondriac, the umbilical, or even the iliac region exhibits the characteristic depression of the hilum, if the pulsation of the renal artery can be recognized, if the growth on manipulation readily recedes into the loin, and if it is of the size and consistence of the kidney, the diagnosis becomes reasonably certain.

The kidney is best palpated with the patient in the dorsal decubitus, thighs flexed, head and shoulders elevated, and the trunk slightly inclined towards the side to be examined by a thin pillow placed under the opposite loin. The examiner places the fingers of one hand just below the twelfth rib, those of the other below the costal margin in front over the position of the lower pole of the kidney, and by gradually increasing bimanual pressure sinks the anterior examining fingers so deeply that the kidney may be felt in its expiratory descent. In the majority of muscular, well-nourished patients with normally movable kidneys these organs cannot be felt by this or any other method of renal palpation. In weak and emaciated women the kidney, even though but normally mobile, can usually be felt on the right side. When the kidney descends so far during inspiration that its expiratory ascent can be prevented by firmly pressing against it with the examining fingers, the mobility is abnormal, and this is still more true when the entire organ can be pressed and held downward by thrusting the fingers upward and backward after a full inspiration. The gravity of renal mobility is, however, gauged by the renal changes and the symptoms produced by it, and these are not necessarily proportionate to the range of motion.

Malignant omental growths, solid tumors of the ovaries, growths of the abdominal wall, and enlargement of the spleen can usually be readily excluded, partly from the radical difference in the history, symptoms, and clinical course, mainly by careful palpation, followed by colonic air-distention and palpation and auscultatory percussion. The kidney lies behind the colon.

Distention of the gall-bladder so closely simulates floating kidney that differentiation is extremely difficult.

Both may be characterized by gastro-intestinal catarrh, jaundice, colicky attacks, albuminuria or biliuria, and the presence of a tumor in the right upper abdominal quadrant. In distinguishing between these two affections the history is of cardinal importance. Enlarged gall-bladder is particularly characterized by extreme ease of palpation, constant or increasing size, the slight influence of posture upon its position, free respiratory movement, its apparent continuousness with the liver substance both on palpation and percussion, and its limited range of mobility under manual pressure. Neither can it be made markedly to recede to the loin. Colicky attacks give no radiation downward and are not attended or followed by hæmaturia. Movable kidney exhibits limited respiratory motion, but a free range incident to palpation or body position; it can be separated from the liver, is at times difficult to feel, varies greatly in size, can be made distinctly more accessible by upward lumbar pressure, and recedes to the loin.

Colicky attacks are associated with pain radiating downward, and are attended and followed by hæmaturia.

Moreover, the pressure upon a tender kidney produces a peculiar sickening much like that incident to testicular trauma. When the surgeon is in doubt, the condition is usually movable kidney.

The two conditions may co-exist. In this case careful palpation will enable the surgeon to separate one tumor from the other.

The distinction between movable kidney and calculus is readily made when each has developed typically; when the mobility of the kidney, though sufficient to cause blocking of the ureters, is so slight that it cannot be detected by palpation, the differential diagnosis is made possible by the skiagraph.

Omental or mesenteric infiltrations or pyloric carcinoma cause neither the colicky paroxysms nor the urinary phenomena of floating kidney.

Prognosis.—The ultimate prognosis as far as the kidney itself is concerned is bad in all cases accompanied by distinct renal symptoms and pathological conditions of the urine. When the pain is slight, or, if severe and paroxysmal, when it recurs at long intervals, lasts but a short time and is relieved promptly by position and rest, and when symptoms are not steadily increasing in severity, the outlook is favorable, and the patient can probably be kept comfortable by the wearing of a proper appliance. Severe, long-lasting pain, of frequent occurrence, necessarily implies ultimate disorganization of the secreting substance of the kidney, since this pain is due to tension or twisting of the pedicle, either of these conditions causing profound alterations in nutrition.

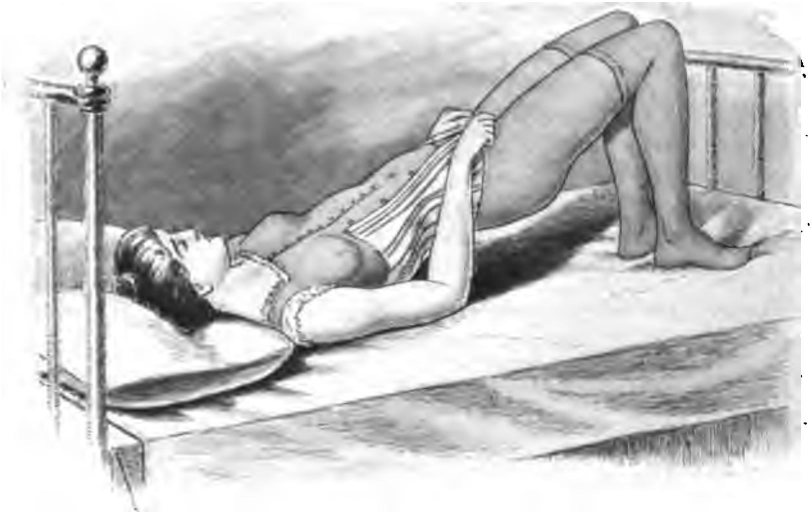
Pronounced mobility may be unattended by renal symptoms or alterations in the urine, and under such circumstances does no harm. An amount of motion which cannot be detected by the most careful palpation may be sufficient to cause pronounced symptoms. Sooner or later a floating and degenerating kidney profoundly alters general nutrition, often producing a condition of melancholia or neurasthenia. The gastro-intestinal symptoms when once well developed are commonly progressive unless the mechanical cause is removed.

Debove cured a case of muco-membranous enteritis by anchoring an intermittently hydronephrotic kidney, and has shown that chronic hydronephrosis of one side may cause interstitial nephritis of the other.

Treatment.—This is either palliative or radical.

Palliative Treatment.—The condition can be palliated, often cured, by a rest cure of five weeks in the dorsal decubitus, with particular attention paid to abdominal massage, correction of slight lateral spinal curvature, exercises calculated to develop the abdominal muscles, and the application of a corset, so planned that the abdominal parietes are evenly supported and enteroptosis is prevented. The straight-front corsets are well adapted to this purpose. The corset must be accurately fitted by measurements taken with the patient in dorsal decubitus with elevated hips, and should always be laced on with the patient in this position. (Fig. 173.) Its greatest pressure should be exerted upon the lower abdominal segment, the front being carried down as far as possible. Moderate support should be afforded at the waist-line, and great care should be taken to see that there is no pressure above this line.

FIG. 173.



Proper method of applying corset for movable kidney.

Patients must be cautioned against violent exertion or straining of any kind. The bowels must be kept soluble, since the muscular effort required to evacuate hardened fæces tends to displace the kidney. Digestive disturbances should be corrected by diet and proper medication, and due attention should be given to general hygiene. The acquisition of abundance of fat is much to be desired. When in spite of this treatment the symptoms of obstruction persist, nephrorrhaphy is indicated.

When sudden violent pain shows that the pelvis or ureter is blocked, an attempt should at once be made to place the kidney in its proper position. In the intervals of paroxysmal pain this is usually accomplished without difficulty. Patients suffering from movable kidney are apt to be thin, with lax abdominal walls: hence the kidney can be distinctly palpated, and pressure can be so exerted that it will slip readily into its normal place.

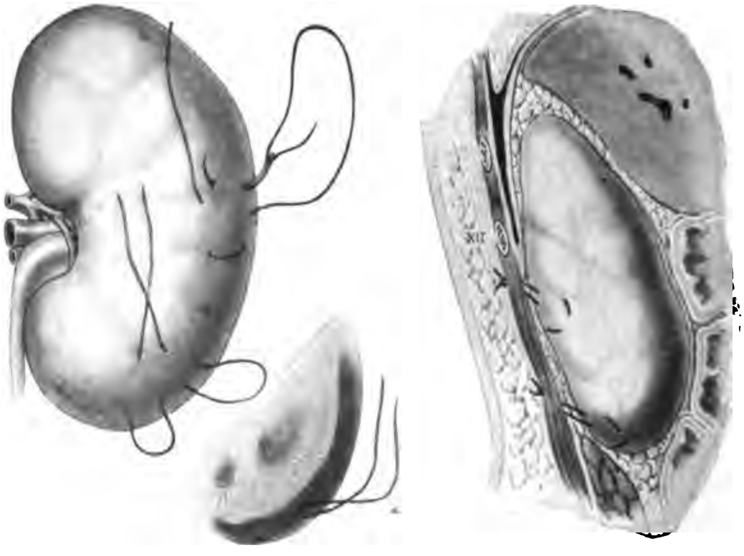
During the attacks of pain, especially when these are complicated by symptoms of local peritonitis, this reposition may be difficult. Nevertheless it should always be attempted, ether being given if necessary. No force should be used, since the surgeon is to a certain extent acting blindly. The kidney should be seized, outlined, mobilized, and restored to its normal position if possible. Severe pain is quieted by a hot bath and the use of hypodermics of morphine, repeated as often as may be necessary. Hot compresses should be applied over the abdominal surface when tympany develops. With the subsidence of acute symptoms renewed efforts should be made to replace the kidney. If these efforts fail, it will be because of inflammatory adhesions.

Operative Treatment.—This has for its end fastening the kidney in its normal position by sutures and adhesions. It is indicated when in association with an abnormal degree of mobility the symptoms are distinctly renal, and do not yield to rest, hygiene, and a proper abdominal support.

The patient is placed on the operating-table, lying nearly in the ventral decubitus, with the side corresponding to the floating kidney up. The head is turned to one side, the forearm brought in front of the chest, the body slightly flexed, and the thighs bent. Beneath the ilio-costal space of the sound side is placed a sand-pillow or roll of material about the size of a man's thigh; this causes slight lateral curvature of the spine and increases the ilio-costal space. (Fig. 181, page 561.)

The instruments required are a strong scalpel of medium size, dissecting forceps, toothed forceps, half a dozen hæmostatic forceps, two broad right-angled retractors, two large curved needles, and a grooved director. Two assistants are required. The twelfth rib having been clearly outlined, an incision is made, beginning half an inch below this rib and about the outer border of the erector spinæ muscle (two inches from the middle line), and running downward and forward towards the iliac crest. This incision should be three or four inches long. It divides the skin and superficial fascia; the latissimus dorsi should be retracted; the external and the internal oblique muscles should, as far as practicable, be split in the direction of their fibres; the posterior and anterior layers of the lumbar fascia and the transversalis fascia are divided, exposing the fibro-adipose capsule of the kidney. The retractors are passed down to the perinephric fat, and the wound is spread open as widely as possible. While an assistant presses the kidney upward and backward into its normal position the fatty capsule is seized in the rat-tooth forceps and opened with a knife, and the edges of the opening are seized in hæmostats, after which the dorsal surface of the kidney is freely exposed. The sutures of chromicized or iodized No. 2 catgut are inserted one in the postero-convex border, one near the upper pole, the other well below the middle, thus preventing inward or forward rotation. Each is passed from above downward for half an inch beneath the capsule, then from below upward the needle entering a quarter of an inch from its previous point of exit for half an inch, coming out near the point of original entrance. Brödel has demonstrated that thus placed the sutures stand three times as much traction as by the older methods, and are hence much less likely to tear out from the effort of coughing or vomiting. These sutures are carried through the fatty capsule, transversalis fascia, and deep muscles, and are tied down after the incision through the muscles and fascia is firmly closed by a sufficient number of buried catgut sutures. No drainage is used. The patient is kept in the dorsal decubitus under rest cure for five weeks.

Fig. 174.



Sustaining sutures for fixing the kidney. (Brödel.)

After operation the patient should lie in the dorsal decubitus for at least five weeks, should wear a supporting bandage or straight-front corset for six months, and should avoid violent strain or muscular effort for a much longer period. The mortality of the various forms of nephrorrhaphy is less than two per cent. Mechanical cure is the rule, and in the majority of properly selected cases complete relief from symptoms may be expected.

When the operation of nephrorrhaphy has been carefully performed twice and has been unsuccessful, or when it is impossible to place the kidney in the proper position, and symptoms are severe and progressive, nephrectomy is a justifiable operation.

Newman gives the mortality of this operation for movable kidney as thirty per cent. The operation is not to be considered unless there is absolute certainty as to the existence of a sound kidney which is able to carry on the work of elimination. For the purpose of total removal the kidney may be reached from in front through the linea alba or the linea semilunaris, or from the lumbar region, as in the operation of nephrorrhaphy. When ureteral catheterization has failed to demonstrate the condition of the other kidney, or even its presence, the abdominal operation is to be preferred.

The treatment just given for movable kidney is applicable to floating kidney; in operating, however, the peritoneal cavity must be opened unless the two layers of the mesonephron are widely separated.

INJURIES OF THE KIDNEY.

In accordance with the customary surgical classification, injuries of the kidney may be considered under the general headings contusions and wounds. In contusions the injury to the kidney is subparietal, no external wound leading down to this organ. In wound of the kidney there is solution in the continuity of the soft parts leading to the seat of injury.

Contusion of the Kidney.—The cause of contusion may be direct or indirect violence.

Direct violence is instanced by kicks, blows, or crushing pressure, as from the wheels of a cart, applied to the lumbar region. Except in cases complicated by fractured bones and injury to other important viscera, the vulnerating body is usually small, or at least narrow, since there is a comparatively small unprotected space through which it can act directly on the kidney, particularly when it is applied suddenly and unexpectedly, thus surprising the parietes when they are relaxed, and when the ilio-costal space is broadest. Direct violence usually involves the right kidneys of men.

Indirect violence is instanced by contortions or flexions of the trunk, or by violent jarring from a fall.

The injury may vary in severity from moderate contusion to laceration, or to complete disintegration.

Tuffier recognizes four degrees of injury. The first degree is characterized by subcapsular ecchymoses. When the violence has been more marked (second degree), intrarenal blood extravasations are found, most marked and constant at the base of the pyramids. In the third degree the capsule is ruptured; there is extrarenal hemorrhage, and deep, multiple, stellate fissures of the kidney-substance are produced, most pronounced about the hilum; sometimes they completely divide the kidney. Finally, the organ may be reduced to a pulpy detritus; exceptionally a large branch of the renal artery may be ruptured. Bleeding within the kidney is rarely profuse. Extrarenal hemorrhage may, however, be fatal.

Severe contusion of the kidney is often complicated by rupture of the liver, the spleen, the intestines, and the lungs; the peritoneum lying in front of the kidney is likely to be torn, particularly in children, in whom the fatty envelope of the kidney is wanting. Mackin has shown that injuries to the kidneys are the most frequent visceral lesions of abdominal contusions, and that, as a rule, other viscera are not involved. The injury is usually on the right side.

Symptoms.—Symptoms of contusion of the kidney are shock, pain, hæmaturia, diminution in the quantity of urine passed, and the formation of a tumor.

Shock is usually pronounced, particularly when the kidney is lacerated or completely ruptured. It is, however, not always a reliable symptom. Thus, Rayer quotes an instance in which a patient, having struck against an angular projection, was so little affected by the accident that he continued his occupation. He died some weeks later, and post-mortem examination showed rupture of the kidney. In cases of slight contusion characterized by superficial or parenchymatous ecchymoses, shock may be entirely wanting.

Pain is usually the first symptom of contused kidney. It varies in intensity from a sickening, weakening ache to an unbearable anguish comparable to that characteristic of nephritic colic. It is felt in the lumbar region, but usually radiates down the ureters, and is often accompanied by retraction of the testis. It may be transitory, or may last for several days. It is often accompanied by nausea, vomiting, and tympany. When it persists it is liable to be paroxysmal, and is then probably due to temporary ureteral obstruction and kidney tension, caused by the passage of clots through the ureter.

Hæmaturia may follow an injury to the abdominal wall, and does not necessarily indicate that the substance of the kidney has been bruised. When it is easily excited it is usually a sign of a masked lesion of the kidney, such as encysted calculus, which may have been dislodged, or a pre-existing thrombus, or tumor, or renal tuberculosis.

When the kidney is contused hæmaturia is practically constant, and is often profuse. Blood may appear in the urine, either immediately after the injury or not for several hours; it may persist for several days, or may be abundant for a day or two and then suddenly cease, because the ureter is blocked by a clot. In this case there will probably be severe renal colic; when the clot is passed pain will cease, and there will be recurrence of blood in the urine. The quantity of blood passed is, as a rule, proportionate to the severity of the lesion. If, however, the ureter is torn across, or if it becomes at once blocked by a large clot, the urine may remain perfectly clear, even though the kidney is pulpified.

The blood usually disappears within a week. Sometimes it persists for several weeks, and exceptionally, instead of growing less, it steadily augments in quantity until the patient perishes of anæmia. The clot, in place of passing through the ureter, may permanently occlude it, causing hydronephrosis or atrophy of the kidney. Butler reports a case in which the left ureter became thus occluded the fourth day after an injury. This was followed by total suppression of urine for fourteen days, and ended in death. The right kidney was found to be cystic and atrophic. Frequent and painful urination is not an uncommon symptom when blood is passing through the ureter in the shape of clots which act as foreign bodies in the bladder; often there is retention of urine.

Alteration in the quantity of urine secreted constitutes an important symptom of kidney contusion. Urine may be totally suppressed immediately after the injury, or this suppression may not develop until some hours later. It is often followed by compensatory polyuria.

The formation of a tumor is primarily due to hemorrhage; even though this be subcapsular the enlargement may be palpable. When the capsule is ruptured and there is free bleeding into the perinephric tissues, there is quickly formed an extensive and increasing area of dulness and swelling in the lumbar and possibly in the iliac region. The hemorrhage may be so rapid and profuse that marked constitutional symptoms develop,—*i.e.*, feebleness and rapidity of the pulse, pallor, coldness of the extremities, and collapse. Tumor of the loin was present in one hundred and eleven of Watson's four hundred and eighty-six cases. It was usually due to perinephric abscess, hydronephrosis, or pyonephrosis; thirty-nine cases having been caused by perirenal bleeding and four by hæmatonephrosis.

Rayer states that in intrarenal bleeding the swelling is sharply circumscribed, forms later and more slowly than in perirenal extravasation, and is rounded and movable. Perirenal extravasation is diffuse. Satisfactory palpation is in these cases often impossible, because of the exquisite sensitiveness of the kidney and the regions about it. When the hemorrhage is confined to the pelvis of the kidney and the ureter it seldom forms an appreciable tumor unless it finds its way up under the fibrous capsule because of such extensive laceration of the renal tissue as to render this capsule easily separable. Usually bleeding occurs immediately, but Rayer reports a case of hæmatoma which was not observed until six weeks after the injury.

Rupture may take place into the peritoneal cavity, a complication which is generally fatal. Intraperitoneal bleeding is characterized by the rapid development of tympanites and signs of peritonitis, together with symptoms of internal hemorrhage.

A perirenal blood effusion is sometimes evacuated with the urine, this occurring, according to Tuffier and Levi, towards the end of the second week following the injury and being characterized by the subsidence of the tumor and the reappearance of blood in the urine, which may have been clear for several days.

Diagnosis.—The diagnosis of contusion of the kidney is based on —(1) The form of traumatism: thus, the sharp corner of a table striking the side between the pelvis and the costal border, a kick or a blow delivered from before backward below the ribs and over the region of the kidneys, a crushing force fracturing the lower ribs, or extreme flexion or extension of the body, would be sufficient cause for kidney-rupture. (2) The immediate appearance of blood in the urine, in the absence of bladder-lesion. The rare cases in which such bleeding follows simple traumatism of the back may be disregarded. If the bleeding is profuse and exhibits worm-like clots, it offers the characteristics of traumatic renal hemorrhage. (3) Marked diminution in the quantity of urine secreted, or complete suppression of the secretion. This symptom may follow any severe traumatism to the abdominal contents. It may be of value when associated with hemorrhage. (4) The rapid formation of a lumbar swelling associated with extreme tenderness. (5) Intense pain radiating in the direction of the ureter and accompanied by retraction of the testes. (6) Subcutaneous ecchymoses developing several days after the injury. These may appear in the loin, or may be found in the inguinal region. Dumesnil has particularly insisted upon the importance of this symptom, and states that it is indicative of serious injury.

This group of symptoms is diagnostic. It has been shown, however, that they are often not associated; thus, hæmaturia, the most characteristic symptom, may be absent; but if the kidney-lesion is extensive a hæmatoma is certain to form. When the peritoneum is ruptured, and extensive bleeding takes place into the general peritoneal cavity, the only symptoms pointing to injury of the kidney will be hæmaturia and possibly characteristic pain; shock and peritonitis quickly mask the other symptoms indicative of kidney-lesion. Abdominal symptoms are occasionally noted, however, in the absence of intraperitoneal rupture; they occurred in eighteen of Watson's cases. They become marked immediately or very soon after the accident, are of relatively short duration, and are not progressively severe. The one sure sign of intraperitoneal rupture of the kidney is free fluid in the peritoneal cavity, as indicated by non-circumscribed, generally bilateral, movable dulness. In cases uncomplicated by peritoneal rupture the area of dulness is unilateral, and is more or less circumscribed, extending three or four fingers' breadth below the costal arch and as far forward as the mid-clavicular line. Upon its progressive rapid increase in size often depends the advisability of operative interference. Progressive, but slow, increase in size of this area of dulness occurs with the development of perinephric abscess (sixteen of Watson's cases), and with hydronephrosis (eight of Watson's cases).

Ruptured bladder is characterized by pain in the hypogastrium with vesical tenesmus and the passage of a small amount of bloody urine, or inability to pass any urine and the finding of an empty bladder. (See page 408.)

Prognosis.—Most cases of contusions of the kidney of the first degree, characterized by subcapsular ecchymosis, heal spontaneously apparently without sequelæ, and probably this is true of the cases exhibiting disseminated extravasations into the substance of the kidney. When the organ is extensively ruptured the prognosis is grave. According to Morris, the two chief conditions upon which recovery depends are the escape of the peritoneum and of the large branches of the renal artery and vein; if a large branch of the renal artery be torn, and death does not follow from bleeding, the gradually increasing hemorrhage is likely to lead by pressure to sloughing of the peritoneum, even though that membrane may have escaped the original injury. Recovery may follow extensive laceration or even complete pulpification of the kidney. This, however, is rare. Duplay and Reclus state that in simple lacerations the mortality is forty-three per cent.; in laceration complicated by rupture of other organs or fractures of the neighboring bones the mortality is eighty-seven per cent.

Complications.—Complications which are immediately threatening to life after rupture of the kidney are shock, hemorrhage, and anuria. Later the chief danger is from sepsis. The majority of contusions escape this complication. The conditions are, however, so favorable for its development that it is one of the most frequent causes of death in patients who survive the immediate effects of the injury. A common cause of infection is the passage of a catheter. If the kidney capsule has been ruptured suppuration extends into the perinephric tissues. Chills, fever, increasing pain and tenderness in the lumbar region, and marked diminution in the quantity of urine secreted, should suggest the probability of infection and should lead to lumbar incision. Death may occur from secondary hemorrhage.

Cystitis is a complication of great gravity; it often follows uncleanly catheterization and may even lead to infection of the sound kidney. Hydronephrosis may develop as a consequence of the blocking of the ureter by a clot; this, in case of infection, becomes converted into pyonephrosis. Traumatic peritonitis from the escape of blood and urine into the peritoneal cavity, and thrombosis of the renal vessels, are sequelæ that have been frequently fatal. The kidney may be displaced from its normal position, and thereafter may remain preternaturally movable. As a remote sequel of traumatism various forms of Bright's disease may develop. Exceptionally the blood-clots form nuclei for renal stones. Ebstein holds that contusion is a predisposing factor in the development of renal tumors.

Treatment.—Shock, if pronounced, is treated in accordance with general surgical principles. When there is reason to believe that the kidney is bruised, the patient is put to bed, is kept absolutely quiet, and is given hypodermic injections of morphine for the relief of pain if this is severe. When the hemorrhage is profuse, ergotin is given hypodermically, an ice-bag is applied to the lumbar region, and the side is strapped with long strips of adhesive plaster, applied as for fractured ribs. In addition to the straps a broad roller bandage is applied; this secures a compress of gauze or cotton over the kidney. It is unwise to give either medicine or food by the mouth for the first few hours, since the patient is likely to vomit, and this may start a bleeding which has already stopped. The straining and retching which occur even when the stomach is empty are best relieved by sufficient doses of morphine. Thirst may be appeased by rectal injections of normal salt solution, a pint at a time, at blood heat.

A fairly well-nourished man can subsist perfectly well for three to five days without nourishment of any kind, and it is wise to withhold even liquid food until the stomach is retentive. For three weeks at least after suspected injuries of the kidney the diet should be liquid, and the intestinal evacuations should be so regulated as to be accomplished without straining. This may require the daily administration of enemata. Morris has seen hemorrhage brought on more than two weeks after the injury by the passage of solid fæcal matter through the colon, thereby giving rise to pressure against the kidney. Coughing, sneezing, forced efforts at micturition, sitting up, any act which may suddenly change the conditions of intra-abdominal pressure, should be avoided. As soon as the stomach becomes retentive, salol and boric acid should be given by the mouth for the purpose of rendering the urine slightly antiseptic, and the patient should drink an alkaline water freely, since the lower the specific gravity of the urine the less the tendency towards the formation of tough clots.

Should retention of urine develop because of clots blocking the urethra. an effort should be made to relieve this condition by a hot bath. This failing, the suction catheter or the litholapaxy tube and evacuator may be used. These instruments must be employed with minute attention to the antiseptic precautions already described in the treatment of retention from enlarged prostate. Sepsis is the most dangerous and frequent sequel, and its usual cause is catheterization. Should the suction catheter or the evacuating-tube not succeed in evacuating the bladder-contents, or should there be frequent recurrence of retention from clots, requiring repeated catheterizations, median perineal cystotomy is indicated, followed by the insertion of a large tube, and by frequent irrigations of the bladder.

Should hæmaturia persist and constitutional symptoms show that loss of blood is producing dangerous anæmia, surgical intervention is imperative. This should take the form of an exploratory lumbar incision. The kidney can thus be thoroughly exposed, the extent of injury determined, and the bleeding stopped by ligature of the torn vessel, ligation and excision of a portion of the kidney, firm packing, or nephrectomy. This last operation is indicated only when the kidney exhibits multiple and extensive lacerations. Lumbar incision is also indicated in cases exhibiting no blood in the urine, but rapidly developing a lumbar tumor associated with symptoms of internal bleeding, and in those showing the constitutional and local symptoms of infection.

Owing to the depth and inaccessibility of the wounded vessels, it may be impossible to tie them, or, even if they were tied, the blood-supply of the kidney might be thereby so curtailed that necrosis would be certain to result. Under these circumstances nephrectomy is indicated. Children are less able than adults to resist internal hemorrhage, but are apparently more likely to recover from nephrectomy. Therefore nephrectomy in them should not be delayed in case of uncontrollable internal hemorrhage from ruptured kidney. In one of Obalinski's cases the indication which led him to perform nephrectomy was the formation in the right hypochondrium on the ninth day after the injury of a tender, circumscribed tumor, the size of a child's head. The kidney was immediately exposed by a lumbar incision, and found almost completely severed and surrounded by a large quantity of healthy urine and small blood-clots. The fragments were removed, the pedicle was tied off, and the wound was packed with iodoform gauze. The patient recovered. Obalinski favors exposing the kidney by laparotomy when after injury there are a rapidly formed tumor, profuse hæmaturia, and other indications of severe hemorrhage. This incision furnishes an opportunity of washing out the peritoneal cavity in case its lining membrane has been wounded and it contains blood or extravasated urine.

Of four hundred and eighty-six cases collected by Watson, one hundred and twelve died; five from associated injury of intraperitoneal organs, twenty-five from suppuration, ten from anuria, nine from peritonitis. Of two hundred and seventy-three cases treated expectantly, twenty-seven per cent. died; of one hundred and fifteen cases treated by nephrectomy, twenty-five per cent. died; of ninety-eight cases treated by operation other than nephrectomy, seven per cent. died. Hemorrhage and sepsis caused the greatest number of deaths.

Wounds of the Kidney.—Wounds of the kidney, much rarer than contusion or rupture, are conveniently classed in accordance with their causes as gunshot, punctured, and incised wounds.

GUNSHOT WOUNDS.—A bullet which wounds the kidney is very likely to injure other viscera. Of seventy-eight cases of gunshot wound of the kidney reported by Otis, other viscera were wounded in thirty-three. Balls usually pass through the kidney, sometimes leaving in its substance portions of clothing; exceptionally they are buried in the secreting portion of the organ: thus, Simon found a bullet encysted in the kidney parenchyma.

The bullet may wound simply the secreting substance of the kidney, may pass through the pelvis, or may tear the great vessels. The modern army rifle, either at close or at long range, may practically pulpify the entire organ. When the wound involves only the kidney-substance there is moderate bleeding with no extravasation of urine, and, provided other organs are spared, healing takes place with extraordinary rapidity.

When the pelvis is opened there will be urinary extravasation. This, however, need not lead to infection. The bleeding is usually more profuse than when only the secreting substance of the kidney is involved, and, unless the ureter is torn completely across, there will be hæmaturia. When the large vessels are cut, hemorrhage is so severe as to threaten life. The blood may be poured out into the perinephric tissues, into the peritoneal cavity, and into the bladder through the ureter.

PUNCTURED WOUNDS, such as those made with a needle in kidney exploration, are entirely safe, unless infection is carried with the vulnerating instrument. When made with a comparatively blunt instrument, as the prong of a hay-fork, there are contusion and laceration in addition to the puncture, and the consequences are the same as those incident to gunshot wound.

INCISED WOUNDS are rare, since the position of the kidney protects it. Incised wounds are much more liable to be entirely extraperitoneal than are those inflicted by fire-arms. The wound of entrance is often in the lumbar region; stabs and cuts inflicted from in front rarely extend backward as far as the kidney. As in the case of gunshot wounds, these injuries may involve the secreting substance, may open the pelvis, may divide the large vessels, or may sever the ureter.

A few cases have been reported in which, after extensive wound of the lumbar region, the kidney has protruded.

Symptoms.—The chief symptom of wound of the kidney is hæmaturia. If the pelvis has been opened there will also be escape of urine through the wound. Pain may be severe, assuming the type of kidney colic; oliguria is constant. Exceptionally there is complete suppression of urine.

Diagnosis.—The diagnosis is based on—1, the nature of the vulnerating body, its direction, and the depth to which it has penetrated; 2, blood in the urine; 3, escape of urine from the wound; 4, examination of the kidney through the wound or through a lumbar or an abdominal incision.

When the entrance-wound of a bullet is over the kidney, and the direction of its track is towards this organ, this constitutes a reasonable ground for suspecting injury to the kidney, since the course of a bullet in the body is usually straight; hæmaturia would then make the diagnosis reasonably certain. The kidney may, however, be injured by a ball which enters the body at a considerable distance from the parietes overlying it. Thus, Otis mentions a case in which the bullet entered just below the clavicle. Hæmaturia and escape of urine through the wound are diagnostic of wound of the pelvis or of the ureter rather than of the kidney.

Palpation of the kidney is sometimes possible through an incised wound, such as would be inflicted by a stab with a broad-bladed dirk; this would make the diagnosis absolutely certain.

Prognosis.—Incised wounds of the kidney heal readily; even though the pelvis is opened and there is escape of urine, this does not materially interfere with recovery, provided the ureteral lumen is not encroached on. These injuries are dangerous chiefly from primary hemorrhage, which is likely to be profuse, and from the wounding of other viscera. Of thirty-one incised wounds collected by Duplay and Reclus, eight died. In six of these the kidney-wound was complicated by involvement of other viscera.

In the absence of profound shock and severe hemorrhage, the prognosis of kidney-wound is favorable, even though the organ is very extensively injured, since in the great majority of cases the wound is unilateral and occurs in persons possessed of a sound kidney capable of performing the work of both. The prognosis of wounds from in front, opening the peritoneum overlying the kidney, is much more serious than is that of extraperitoneal wounds.

Gunshot wounds commonly involve other viscera. Thus, of thirty-eight cases collected by Duplay and Reclus, sixteen died; eleven of these deaths were attributable to multiplicity of the lesions. The complications and sequelæ of wounds of the kidney are those described when considering contusions; the danger of infection is greater in wounds than in contusions, since it may reach the kidney either from the ureter or from the parietal opening.

Treatment.—The general treatment of wound of the kidney is that already described as appropriate to contusion. The wound itself should be scrupulously disinfected, and should be drained, even though there be no escape of urine, since the vulnerating body is never sterile.

When a bullet entering the body from in front has passed towards the kidney, and there follow hæmaturia and symptoms of internal hemorrhage, cœliotomy should be performed at once, since this enables the operator not only to deal with the kidney, but to recognize and close wounds of the abdominal viscera.

When the wound is in the lumbar region and there is doubt as to whether or not the peritoneal cavity has been entered, the lumbar incision is preferable. The indication for immediate operation, as far as the kidney is concerned, is hemorrhage. The kidney having been exposed, either by an incision through the linea alba, along the outer border of the rectus muscle, or in the lumbar region, according to the position of the wound, the bleeding point is sought for and secured, by ligature, if this is possible, or by packing in case the ligature cannot be applied and there seems a fair prospect of saving the kidney, or by nephrectomy.

If the wound involves only the secreting portion of the kidney, it should be cleaned, drained, and packed. If the renal artery is torn, or if the kidney is so extensively disorganized that repair is absolutely impossible, nephrectomy is indicated. If the pelvis is opened, it should be closed by suture, if possible; if not possible, provision should be made for lumbar drainage. If the ureter is torn across its upper portion, lumbar drainage is usually indicated, since from loss of blood the patient is not prepared to stand a prolonged plastic operation. Should recovery take place, implantation of the ureter into the pelvis may be effected subsequently. Blood or extravasated urine found in the peritoneal cavity should of course be removed by sponging, the kidney being then shut off from this cavity by suture of the peritoneum. Extensive accumulation of blood in the perinephric and post-peritoneal tissues should be removed, since huge abscesses will otherwise develop if infection occurs.

Incised wounds of the kidney are treated by gauze drainage if hemorrhage is moderate. If it is persistent and severe, the kidney should be exposed by lumbar incision, the bleeding vessels, if large, secured by ligature, or the hemorrhage stopped by packing, and the kidney-wound closed by catgut suture. Stitches are serviceable in these cases as a means of hæmostasis; they also materially hasten the process of cicatrization. When a large portion of the kidney is almost entirely cut away, this should be removed. If the renal artery is cut, nephrectomy is indicated.

Nephrectomy.—When the wound is extraperitoneal the lumbar route may be chosen, though many surgeons of experience have abandoned it in favor of the abdominal operation.

The incision should be four inches long, beginning about two and a half inches from the spines of the vertebræ, and running parallel to the twelfth rib, and a full half inch below it, in order to avoid wounding the pleura, which sometimes extends down to the twelfth rib. This wound may be enlarged, if necessary, by another incision carried downward from its inner third to the crest of the ilium. When the kidney has been exposed, as in nephrorrhaphy, and freed from any adhesion to its fatty capsule, and blood-clots have been removed, its pedicle should be double clamped with forceps, and it should be removed by cutting between these instruments, after which the vessels and the ureter are separately ligated. The kidney can then be drawn out of the wound and the vessels and the ureter tied off again near the pelvis of the kidney to prevent escape of urine into the wound, and the pedicle cut between the two ligatures. The wound should be irrigated with sterilized water or sublimate solution and packed with sterile gauze, or it may be partially closed and drained with a rubber tube, which should be removed in three or four days.

Nephrectomy through an incision in the linea semilunaris, known as Langenbuch's operation, is indicated when the wound has probably involved other organs and has opened the peritoneal cavity. This incision to allow of free manipulation should be at least four inches long. When bleeding points have been secured and the abdominal cavity has been opened, as in all other laparotomies, the opposite kidney is palpated, not only to make sure of its existence, but, furthermore, to ascertain, as far as possible, its condition of health and whether or not it can endure the strain of double duty. If it be absent or diseased, the operation must be abandoned. If this examination of the uninjured kidney shows that it is probably healthy, the intestines are pushed aside from the affected kidney, the outer layer of the mesocolon is exposed, and a vertical slit is cut in it over the kidney, the general cavity being sufficiently protected by careful gauze packing.

If the peritoneum has been wounded, blood and extravasated urine are sponged out and intraperitoneal injuries are treated before dealing with the kidney, unless there is bleeding; in that case no time is lost in fully exposing the organ. The kidney is enucleated from its fatty capsule as in the lumbar operation, and the vessels and ureter are tied off and divided. It is advisable in this operation to provide drainage through a lumbar wound for three or four days. Unless there are lesions of the abdominal viscera, or unless from the nature of the wound it is probable that infection will follow, the peritoneum overlying the kidney should be completely closed by suture, and the abdomen closed without drainage. When abdominal nephrectomy is performed after infection has developed, the peritoneal cavity must be freely drained.

In abdominal nephrectomy performed through an incision in the linea alba the operation is exactly the same as an ordinary abdominal section up to the time when the inner layer of the mesocolon is incised in order to reach the postperitoneal kidney-space. Thereafter the procedure is the same as in Langenbuch's operation. Profuse hemorrhage from cutting one of the large veins running along the inner layer of the mesocolon frequently happens; this may be prevented by cutting in the line of the veins, or by tying beforehand those vessels which inevitably must be cut. Drainage should be secured through a counter-opening in the lumbar region.

The main advantage of the abdominal route is the opportunity it affords of examining into the condition of the uninjured kidney and of detecting and repairing associated injuries of the intraperitoneal viscera.

Foshay studied the changes in the urine after nephrectomy in two cases, and in both found evidence of temporary hyperæmia of the remaining kidney.

Meyer, after reporting a case of anuria following nephrectomy, in which nephrotomy was performed, remarks, "There evidently occurs an excessive hyperæmia in the remaining kidney immediately after nephrectomy. Its presence is demonstrated by the sudden change in the transparency of the urine if that remaining kidney had already been slightly affected. It has been observed by many who have done several nephrectomies that in a number of cases immediately after the one unhealthy kidney has been removed the urine which descends from its probably only slightly affected fellow, and which had formerly been found comparatively clear, with the help of cystoscopy, or after nephrotomy on the other side had been done, suddenly becomes very turbid, and presents an unusually heavy deposit after short standing. As I have seen, it can take weeks or months before this turbidity lessens or disappears. In the majority of cases it does so, however, but slowly and gradually."

Schede also mentions the arterial pressure necessarily present and suddenly increased in the remaining kidney after nephrectomy on the opposite side. He is inclined to regard it as the probable cause of the acute epithelial necrosis in the tubuli contorti of the kidney, which has been found on microscopical examination of the remaining kidney in a few instances after nephrectomy, and to which the immediate fatal result of the operation evidently was due.

CHAPTER XV.

KIDNEY CALCULI.

URIC ACID CALCULI are found more frequently than any other form of kidney stone. Next come oxalate calculi. These are both deposited from acid urine, and are partly dependent for their formation on systemic conditions.

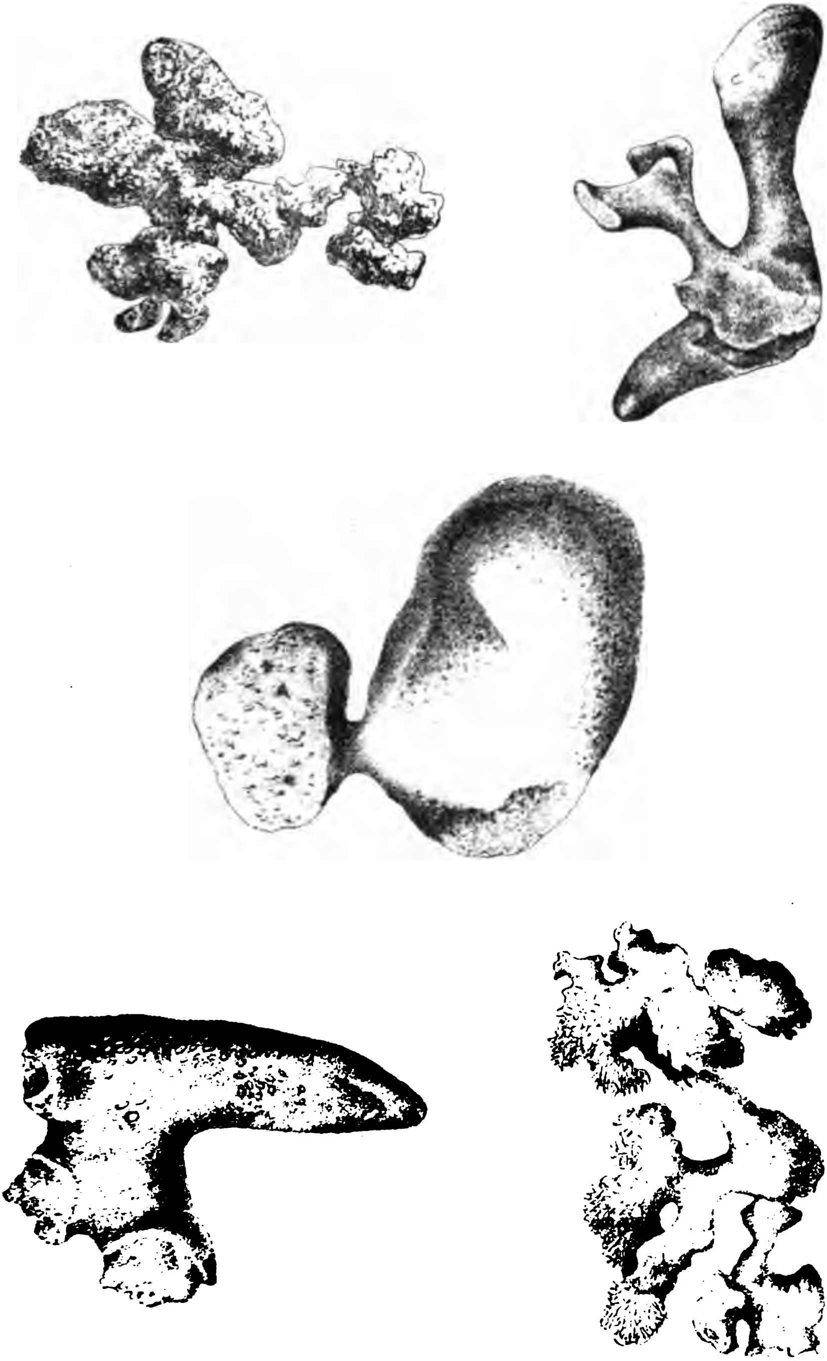
Phosphatic calculi and those made up of calcium carbonate are less frequent. They are deposited from alkaline urine, and infection is a strong predisposing factor in their formation. Litten has shown experimentally that temporary ligature of the renal artery is followed by calculous infiltration of the degenerated epithelium, which subsequently may be transformed into true calculi.

Cystin, xanthin, ammonium urate, or other urates are rare as the principal ingredients of kidney stone. It is possible that calculi may originate in the renal pelvis about a minute clot. Exceptionally concretions are found made up almost entirely of inspissated blood. Foreign bodies serving as nuclei are extremely rare. Franks has, however, reported a case in which an ordinary sewing-needle formed the nucleus of stone which caused an extensive perinephric abscess. The needle had been swallowed in childhood, and had finally penetrated the pelvis of the kidney and there become encrusted with urinary salts. Rosenstein found a calculous deposit about a hair, evidently from a dermoid cyst of the kidney.

The number of calculi may vary from one to a thousand. In shape they are seldom round or regular, owing both to the shape of the cavity wherein they are contained and to their restricted attrition from motion. One large calculus and numerous small ones may be found filling up the renal pelvis, in which case the larger calculus acting as a ball-valve may partially close the entrance to the ureter and only occasionally allow smaller calculi to pass down. Such may be the case when frequent attacks of renal colic are followed by the passage of small calculi per urethram, but the general symptoms do not ameliorate.

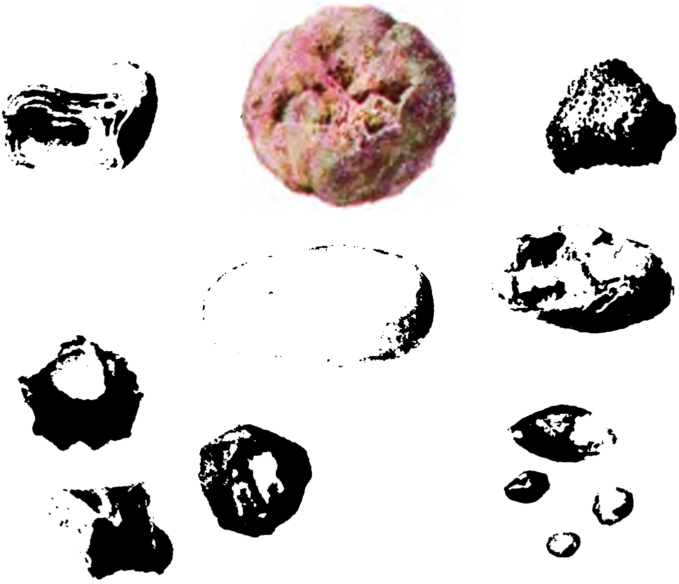
Kidney calculi are usually found in the pelvis or its branchings. Exceptionally they are placed in the substance of the kidney, as is the case when the urate infarcts of the newly-born form true stones. In

FIG. 175.



Various forms of kidney-stone, illustrating the irregularities in shape. (Torres.)

FIG. 176.



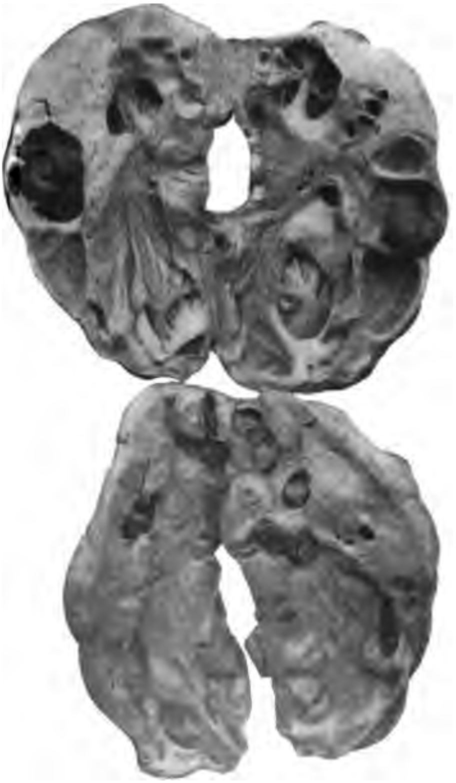
Louis Schmidt fec.

Various kinds of urinary calculi.

the absence of infection calculus is generally adherent, taking the shape of the portion of the pelvis in which it is placed, often bifurcating and branching like a piece of coral, and representing a rough mould of the pelvis and its subdivisions. (Fig. 175.) When infection has taken place, calculi may be found in any portion of the pelvis, perhaps most frequently in its upper and lower extremities. Both kidneys are affected in about fifteen per cent. of cases.

A calculus of moderate size may remain indefinitely in the kidney without producing the slightest pathological change in the secreting structure. If the calculus is so placed that it suddenly and completely blocks the ureteral orifice, the kidney will atrophy. As a usual sequel there is gradual dilatation of the pelvis and its branches, due to partial obstruction. This may result in either hydronephrosis or atrophy. When infection has taken place,—and this occurs, as a rule,—there result pyelonephritis, pyonephrosis, and often secondary purulent deposits. As a complication of the kidney infection an indurative or suppurative perinephritis may develop.

FIG. 177.



Multiple bilateral renal cysts and calculi. (Specimen in Philadelphia Hospital Museum.)

Uric acid stones form two-thirds of all renal calculi. (Prout.) They vary in size from that of a grain of sand to that of a goose-egg. The surface is usually smooth, sometimes granular; the color is dark yellow or red. The whole concrement may be made up of uric acid. Frequently it is composed of a nucleus of uric acid with oxalate layers placed about this, and finally a superficial coating of the earthy phosphates.

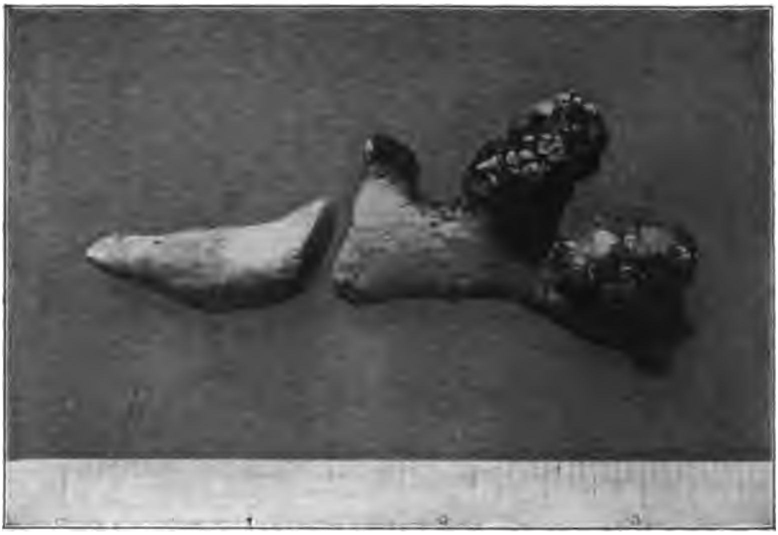
Oxalate stones, formed about a nucleus of epithelium, have been found in the secreting substance of the kidney; they are apt to be of a dark brown or black color. When found in the pelvis of the kidney they are generally round if single, faceted if multiple, with a rough surface. They are harder than the uric acid calculi. They ordinarily show a nucleus of uric acid.

Cystin calculi are commonly made up of this ingredient alone. They are light yellow in color, and exhibit a smooth or a rough surface; they turn greenish or bluish on exposure to air.

Xanthin calculi are extremely rare.

Phosphate calculi do not often form the entire bulk of a concrement. They are usually deposited as an outer shell upon the uric or oxalate stones. They are light gray in color and comparatively soft.

FIG. 178.



Renal calculus. (Actual size.) (American Text-Book of Surgery.)

Calcium carbonate stones are exceptional in man. Marcet has found in diverticula of the pelvis yellowish or grayish concrements of dense elastic structure made up entirely of fibrin.

In dealing with renal calculi the degree of hardness is of no moment. Owing to their position, it is impossible to crush them or wash them away from the pelvis of the kidney; they must either be removed entire, or, if soft and friable, be broken up and removed with a scoop.

Etiology.—The formation of kidney calculi is due to the precipitation in the kidney tubules or pelvis of the solid constituents of the urine. This precipitation always takes place on an organic base. This may be mucus, epithelial cells, blood-clot, or colloid material;

it has already been mentioned that a coagulation necrosis of cells caused by interference with the circulation favors deposition of lime salts. All concrements, whether they be the size of a grain of sand or of a goose-egg, have a distinct albuminoid framework upon which the constituents of the urine are deposited. The difference between sand and sediment lies in the fact that in the former the crystals are conglomerated about this organic framework.

Diathesis possesses a distinct influence upon stone-formation, which is commonly associated with the uric acid, the oxalate, or the phosphatic diathesis. Ebstein holds that the excess of urates, oxalates, or phosphates in the urine does not form stone by direct deposition in the excretory canals or pelvis of the kidney, but that these ingredients favor a coagulation necrosis of cells, which furnishes the organic framework essential for calculus formation; the same effect is produced by local sepsis.

Heredity exerts a direct influence on the development of kidney calculi. Leroy d'Étiolles records the fact that of a family of eight brothers who lived in various parts of Europe under different conditions of hygiene all had calculi. Toel observed calculi and gravel in a mother and two daughters.

Uric acid kidney stones have been found in the fœtus. In general renal calculi are most frequently observed in children and after the fortieth year. The uric infarct of the newly-born, appearing as a deposition of red and brown crystals, particularly of ammonium urate, in the epithelium of the pyramidal tubules, may account for the frequency of vesical calculi in children; kidney colic is, however, rare at an early age.

Renal calculi are commoner in men than in women, the ratio being given as three to one. Duplay and Reclus, however, hold that the two sexes are equally affected.

Hygienic surroundings, climate, and diet seem to have a definite relation to the formation of kidney stone, but one which has not been clearly formulated. Moist climates and sudden changes of temperature apparently predispose to calculus-formation.

Men who lead sedentary lives and indulge in high living are more liable than others to urinary concretions. The frequency with which renal calculi are found among the children of the poorer classes has been attributed to unfavorable hygienic surroundings and coarse diet. It is believed to be due to the absence of milk from the diet of such children. This is an original observation of Mr. Cadge, and is well illustrated by the story which he has published in corroboration: "A few years ago, after removing a stone from a child of well-to-do parents, I was remarking to one of my assistants that this was the first instance in my practice, and that I attributed the general absence of stone in such persons to the free use of milk; the mother volunteered the statement that in a large family this was her only child who never could take milk, and who therefore never had had any."

In opposition to this belief it is interesting to note that Cantani believes that the ingestion of starches and of milk plays a major *rôle* in the production of kidney calculi.

Symptoms.—The chief symptoms of renal calculus are pain, hæmaturia, frequent urination, fragments of calculus appearing with the urine, pyuria, oliguria or suppression, and symptoms of gastro-intestinal disturbance. A stone may, however, be present in the kidney for many years, or through an entire lifetime, without producing symptoms.

The symptoms caused by kidney stone are due to obstruction rather than to the presence of a foreign body: hence the position of the stone is of more importance than its shape or size. Guyon comments on the tolerance of the kidneys and ureters to foreign bodies as contrasted to their sensitiveness to distention.

The pain of renal calculus is commonly referred to the lumbar region of the affected side. It is constant and aching in character, and is increased by motion, by jarring, and by pressure over the kidney. It begins as a feeling of weight or tension rather than as an actual pain. It is subject to sudden exacerbations, often occurring at night when the patient is completely at rest. It may be referred to the healthy kidney. Neuman reports two such cases, which were corroborated by the skiagraph and by subsequent operation. In its exacerbations it usually radiates along the course of the ureter and into the testicle, and may cause contraction of the cremaster muscle, with retraction of the gland. It may be referred to the thigh or the calf of the leg.

The reflexes of renal calculus occasionally take the form of intestinal disturbances, characterized by vomiting and violent intestinal colic. Rectal and vesical tenesmus are not rare. Urgent and painful urination is often so marked that attention is diverted from the kidney to the bladder.

Renal tenderness elicited on deep palpation is a valuable symptom. Lloyd lays considerable stress upon the characteristic stabbing pain which is caused by deep percussion over the loin of the affected side.

Attacks of kidney colic when they are recurrent and are induced by bodily activity are particularly characteristic of renal calculi. (See page 516.) Perfectly typical paroxysms may, however, occur without the presence of stone. This is proved not only by the large number of cases reported in which, the diagnosis having been based mainly on this symptom, the kidney was opened and no stone found, but also by the cases in which, the kidney having been exposed to sight and touch, rhythmical contractions of the ureter were observed. This offers another explanation,—that of ureteral colic, which may be excited by divers conditions, and would naturally have subjective symptoms very like those characterizing kidney colic.

Hæmaturia is usually slight and transitory, and, except after the attacks of kidney colic, can often be detected only by microscopic examination. Clots are rare. The amount of blood in the urine is increased by jolting, walking, muscular efforts, or renal palpation; there is sometimes enough to give the urine a smoky appearance. Sometimes bright-red blood is passed, but this is much more characteristic of tumor than of calculi; this is true also of clots. Rest in bed exerts a prompt and markedly beneficial effect upon the hæmaturia. There are often found in the urine blood-cylinders,—*i.e.*, casts of the uriniferous tubules made up of blood-cells; these are absolutely characteristic of hemorrhage of renal origin.

Frequent urination, as a pure reflex from renal and ureteral irritation, is often a troublesome symptom during the daytime, but is relieved when the patient is at rest. Jacobson observes that nocturnal and diurnal frequency of urination, when associated with other symptoms suggesting renal calculus, indicates renal tuberculosis with extension of the process to the bladder-walls, rather than renal calculus. The frequent urination of kidney calculus is usually unattended by pain. When, together with frequency and urgency, there are marked tenesmus and suffering during and after the act of micturition, these symptoms are attributable to concomitant inflammation.

The passage of gravel or of fragments of calculi is a symptom commonly wanting; when present it is of great value as indicating kidney stone, even though its passage along the ureter does not cause symptoms of kidney colic.

Diminution or total suppression of the urine lasting for a few hours is a fairly frequent symptom of kidney colic. When it lasts a much longer time it should be attributed to the simultaneous obstruction of both ureters, or to obstruction of the ureter of the only functioning kidney.

Exceptionally this obstruction may begin insidiously, attracting no attention until the symptoms of uræmia set in. For six or eight days there may be no characteristic symptoms other than failure to pass water. After this period constitutional symptoms develop, in the form of stupor, tympany, diarrhœa, subnormal temperature, dry black tongue, often hiccough and uræmic odor of the breath. The obstruction is usually placed in or near the pelvis: hence lumbar incision and nephrotomy are indicated.

Gastro-intestinal disturbances are either reflex or due to imperfect elimination on the part of the crippled kidneys. Tympany, vomiting, and exquisite tenderness at times complicate and greatly obscure attacks of renal colic. Chronic epigastric tenderness, feeble digestion, and constant pain may direct the attention entirely away from the kidney.

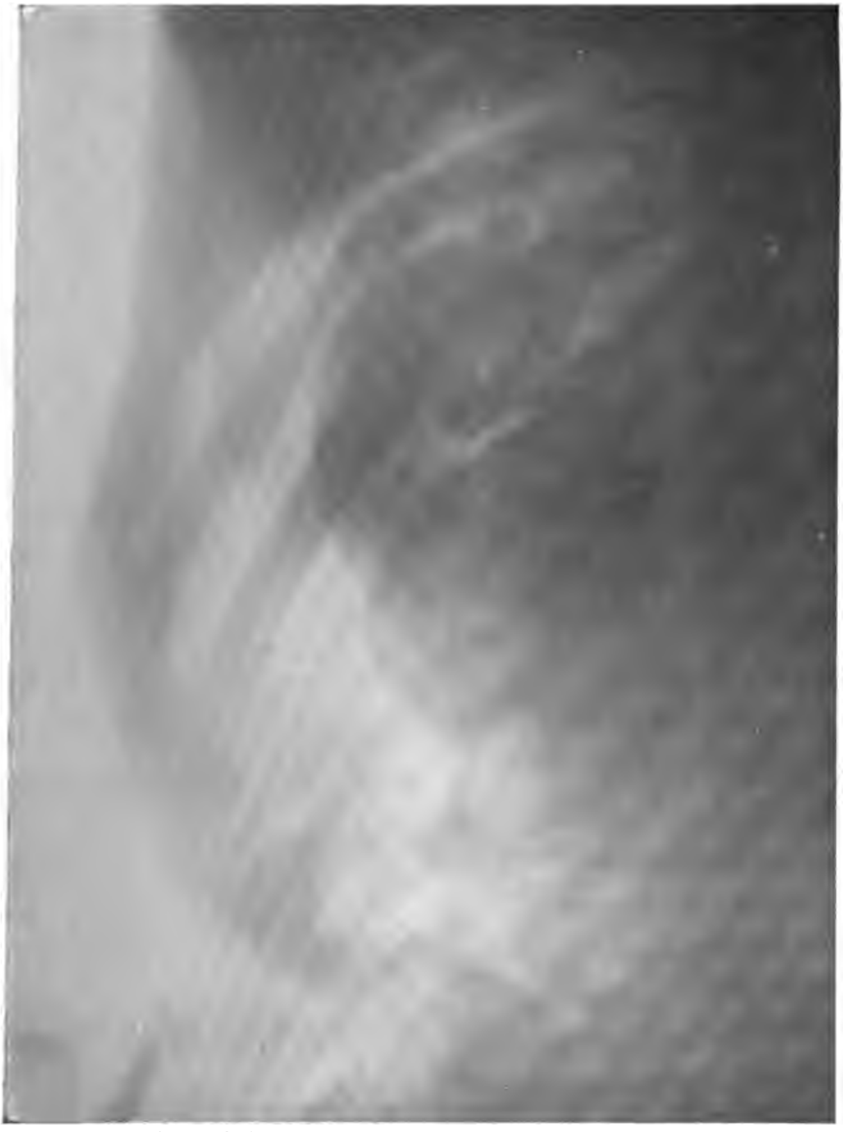
Pyuria is a sign of pyelonephritis; it is classed as a symptom of kidney calculus simply because it is so frequent a complication; infection markedly aggravates the pain, the reflexes, and the other symptoms already described; it also causes fever and favors the development of pyonephrosis.

Diagnosis.—The diagnosis of kidney stone is based on lumbar pain with intercurrent attacks of nephritic colic, slight albuminuria with hyaline casts, hæmaturia, the passage of gravel or of fragments of calculi, renal tenderness, and the use of the X-ray. These symptoms are rarely all present. Pain and hæmaturia are the two most constant, and, with the exception of the passage of calculus fragments, the most characteristic. Tenderness may be elicited either by palpation or by directing the patient, while in a standing position, to strongly flex the thigh of the affected side and then suddenly extend it, bringing the heel forcibly to the floor. If a calculus be present, this movement, called the stamping test, may cause sudden acute renal pain. (Lucas.) Movable kidney often causes constant pain and acute exacerbations precisely like those which arise from stone. Sometimes blood is mixed with the urine, but only after an acute attack of pain; the movable kidney can sometimes be felt in its abnormal position.

Nephralgia may simulate renal calculus in all respects except in the presence of blood or pus in the urine, though Sabatier states that this affection also causes hæmaturia. Large quantities of limpid urine of low specific gravity are passed, and the suffering is aggravated at the catamenia.

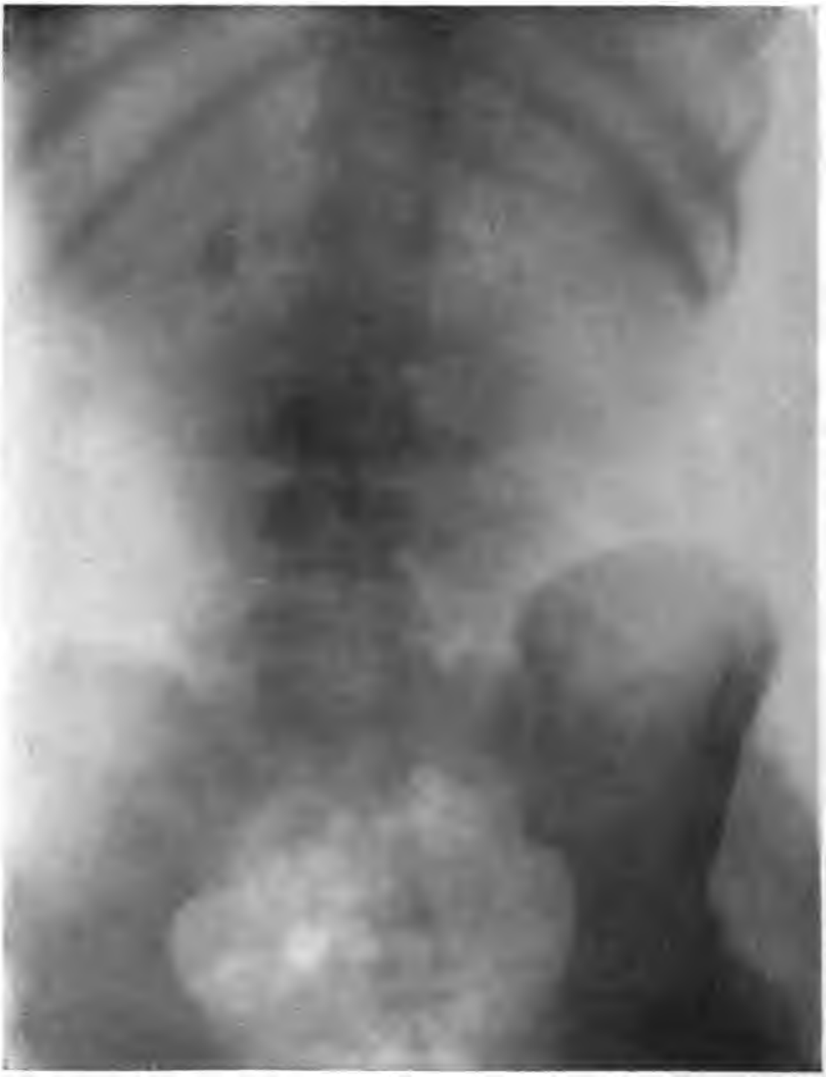
Tuberculosis of the kidney in its early stages may simulate renal calculus so closely that an exploratory incision will be required before a differential diagnosis can be established. There is hæmaturia which is apparently causeless, and the characteristic reflexes develop. Renal tuberculosis is often associated with hereditary dyscrasia and tubercu-

Fig. 179.



Roentgen ray shadowgraph showing calculus in the pelvis of the left kidney. The renal artery and the colon are also shown.

FIG. 180.



Calculus impacted in first portion of ureter. (Skiagraph made by Dr. H. K. Pancoast.)

lar infiltration of the epididymis, prostate, and vesical walls. Moreover, repeated and patient search will sometimes show the tubercle bacilli. Tubercular kidney seems more subject to mixed infection than is the case in calculous kidney : hence there is often a great deal of pus in the urine; this may be thick and contain caseous particles, which rapidly settle to the bottom of the vessel in which the urine has been passed.

Malignant growths are characterized by hæmaturia much more pronounced than that due to calculus, clots often appearing in the urine in the shape of ureteral moulds; the growth rapidly and steadily increases in size. Fragments of the growth are sometimes passed in the urine, and these in obscure cases may be the only reliable means of forming a diagnosis. Exploratory operation is justifiable under these circumstances.

Oxaluria and strongly acid urine cause dull ache, paroxysmal pain, and hæmaturia. The pain is, however, not materially increased on exertion, the tenderness is not distinctly marked on deep palpation, and treatment is followed by prompt relief.

Pyelitis cannot be distinguished from renal calculus with infection except by the history of the case. Pain is not likely to be so distinctly paroxysmal.

Spinal caries involving the lower dorsal or the lumbar vertebræ may in its symptomatology closely simulate kidney stone. Thus, Wright reports a case characterized by increased frequency of urination, intermittent attacks of pain causing nausea and vomiting, testicular pain and local tenderness, and oxaluria. An abscess had formed in the neighborhood of carious vertebræ and by pressure on the kidney had caused symptoms of calculus.

The distinction between kidney stone and gall stone may be quite impossible during an acute attack of colic. The anterior position of the pain and tenderness with backward and upward radiations, the absence of blood or pus from the urine, the abundant secretion during the attack, and a preceding history of persistent gastro-intestinal disturbances and attacks of jaundice would all suggest hepatic colic. Appendicitis has frequently been confounded with renal calculus complicated by hydro- or pyonephrosis, but is characterized by the seat of the tenderness and tumor, the persistent character of the pain and gastro-intestinal disturbances, the unmistakable rigidity of the right rectus muscle, the absence of blood and pus from the urine, and the pronounced pyrexia and leucocytosis. Marked flexion of the thigh is more common in renal colic than in appendicitis.

Locomotor ataxia and hysteria may produce symptoms closely simulating those of renal calculus. Examination of the urine should exclude kidney stone.

It will thus be seen that in many cases a positive diagnosis of renal calculus cannot be made. This is well shown by the history of renal surgery. Even the X-ray may fail to show a stone, and this is particularly the case with uric acid calculi.

Morris has reported twenty-eight cases in which he was unable to confirm the presence of a stone, although the symptoms strongly suggested that this was present. Tubercular nephritis, pyelonephritis, perinephritis, movable kidney, prostatic abscess, calculus of the prostate, encysted stone in the lower end of the ureter, disease of the neighboring organs, and disease of the vertebræ, with consecutive perinephric pus-formation were some of the conditions encountered. In some cases neither stone nor any other cause for symptoms was found.

In thin persons, and when there are many concrements, on palpation both tumor and crepitus can be detected, the latter particularly by combining palpation with auscultation. This is, however, exceptional.

The most characteristic diagnostic symptoms, placed in their order of importance, are an unmistakable skiagraph, passage of gravel or of fragments of stone, attacks of typical renal colic, hæmaturia, and ultimately pyelitis. It is clear that prolonged study of the urine is necessary before forming a diagnosis, the results of this study often sufficing to exclude affections which simulate renal calculi.

Diagnosis of Uric Acid Calculi.—The concretions are finely powdered, and a portion in a test-tube is treated with dilute *cold* hydrochloric acid; if effervescence occurs, carbonates are present, and if the material dissolves, it is not uric acid. If only a very little or no solution occurs, the residue is treated with a large quantity of *warm* dilute hydrochloric acid. The sulphates, oxalates, phosphates, cystin, and xanthin will now go into solution, and any residue is presumably uric acid. This may then be filtered off, dried, and heated on platinum foil; a distinct odor of bitter almonds (HCN) speaks for uric acid. Finally, the murexid test may be applied to make the diagnosis certain. A small quantity of the material is dissolved in nitric acid, and a few drops of the solution evaporated to dryness in a porcelain dish ; the residue should be red. A drop of ammonium hydroxide will produce a purple color, a drop of potassium or sodium hydrate a reddish-blue. (Crofton.)

It is of extreme importance to determine whether one or both kidneys are calculous, and if but one kidney is affected, whether the other is healthy.

The seat of pain and particularly the location of tenderness on palpation are valuable in determining the kidney affected. The passage of normal urine free from blood or pus during attacks of renal colic points to the existence of a healthy kidney, though the absence of this sign—*i.e.*, the passage of purulent blood-stained urine—does not necessarily show that both kidneys are affected, since the obstruction in the ureter of the affected side may not be complete. When there is pyuria and an operation is contemplated, the question may be settled by the use of the catheterizing cystoscope.

The final diagnosis of kidney calculus, and this is always justifiable when the integrity of the kidney is seriously threatened and when the patient's health is progressively failing, is direct exploration of the kidney pelvis by means of a lumbar nephrotomy.

Prognosis.—In the absence of symptoms of obstruction or infection the prognosis of kidney stone is favorable. The foreign body may remain years in the pelvis or calices of the kidney, causing no symptoms other than occasional hæmaturia or perhaps pain, and not seriously affecting the secreting substance of the organ. When obstruction develops, if it is transitory, due to the passage of a stone into the bladder, and is completely relieved by the escape of the calculus, the urine not persistently showing albumin and hyaline casts, the prognosis is still favorable. When the obstruction is not promptly relieved, but becomes chronic, the prognosis as to the integrity of the kidney is grave. When infection takes place, the prognosis is always grave unless prompt operation is practised. The combination of obstruction and infection imperatively calls for operative interference.

Treatment.—The preventive treatment of kidney calculus is indicated when the passage of sand or gravel, or a microscopic examination of the urine, shows that there is an excess of solid constituents. In case the sediment or sand is made up of uric acid, out-of-door exercise, abstinence from alcoholic drinks, baths and surface friction, careful regulation of the diet, and the ingestion of large quantities of water, particularly Carlsbad, Friederichshall, and Londonderry, are indicated.

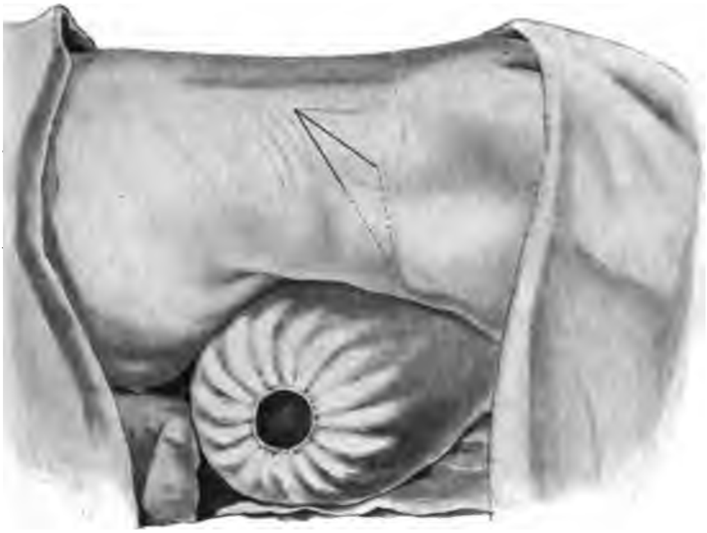
When the sediment is made up of calcium oxalate, in addition to exercise, diet, and diluents, nitrohydrochloric acid is of service. Deposits from alkaline urine require treatment directed either against alkaline dyspepsia or local infection.

Patients subject to lithiasis should eat sparingly, should especially avoid dark meats, sugars, highly seasoned food, rhubarb, tomatoes, asparagus, and strawberries, Burgundy, champagne, and malt liquors. They should drink freely of pure waters, which by decreasing the proportion of salts in the urine lessen the formation of new calculous material, and by increasing the volume of urine aid in the discharge of any that has already been deposited in the kidney. Potassium citrate, lithium carbonate, and sodium phosphate are the most valuable alkaline diuretics. These drugs may be given in doses of from five to twenty grains three to six times a day well diluted. Moderate exercise is highly desirable, but it should not be carried to the point of extreme fatigue or excessive perspiration. All excesses should be avoided, especially those which may be followed by gastro-intestinal or hepatic disturbances.

Palliative treatment for severe pain, particularly that characteristic of renal colic, is mainly limited to the free use of anodynes. The methods of using anodynes, and the doses, have already been described under Diseases of the Ureter.

Nephrolithotomy.—The absolute indications for the performance of nephrolithotomy are harassing, persistent pain, with frequent overwhelming exacerbations, yielding only to the almost continuous administration of anodynes, hydronephrosis, pyonephrosis, hyaline casts, albumen in the urine, and anuria. The route chosen is, with few exceptions, the lumbar one. The single advantage presented by the abdominal incision is that it allows of exploration of both kidneys. The incision for exposing the kidney is that already described. (Fig. 181.) In fat patients it is not easy to find the twelfth rib by palpation; in these the ribs should be counted from above downward. The patient is placed either on his sound side in the half ventral decubitus with a roll beneath the loin, or in the full ventral decubitus with Edebohls' air-cushion eight inches in diameter lying with its centre of maximum pressure a little above the umbilicus. The incision is carried from the angle made by the twelfth rib and the erector spinæ muscle—*i.e.*, from the lower border of the twelfth rib two inches from the middle line of the back, downward and forward for four inches towards the anterior superior spinous process of the ileum. The incision is carried through the anterior portion of the latissimus dorsi and the upper part of the serratus posticus inferior. The fascia covering the erector spinæ muscle should not be opened. The external and the internal oblique muscles are successively cut through; between the latter and the transversalis (lumbar) fascia the last dorsal nerve and intercostal artery are usually encountered; the former should be preserved if possible. The outer border of the quadratus lumborum muscle is then retracted and the anterior layer of the lumbar fascia and the fascia transversalis are divided, exposing the fatty capsule. If the first incision does not allow of full exposure of the kidney to both palpation and inspection, it should be enlarged both upward and downward. The perinephric fat is opened widely, and the kidney is thoroughly exposed through its entire surface and is drawn well into the wound by traction on the perinephric capsule, supplemented, when the ventral decubitus and the air-cushion are used, by so pulling the patient's ankles that the air-cushion placed beneath the abdomen is rolled from below upward. The kidney is then palpated by the fingers of the two hands placed on either side, special attention being devoted to the hilum and to the two extremities. If the calculus cannot be detected by this means,—and this may well be the case, since even after the kidney has been removed from the body palpation has failed to detect a stone in its substance,—an incision should be made through the kidney-substance. The incision which will cause the least possible hemorrhage must be made in the line of separation of the two vascular systems and must not be angled towards the centre of the kidney. Usually this vascular area lies parallel to Brödel's white line and one centimetre away from it towards the posterior surface of the organ. (Fig. 182.) The bleeding is often alarmingly profuse, but is usually checked by packing or the use of hot water.

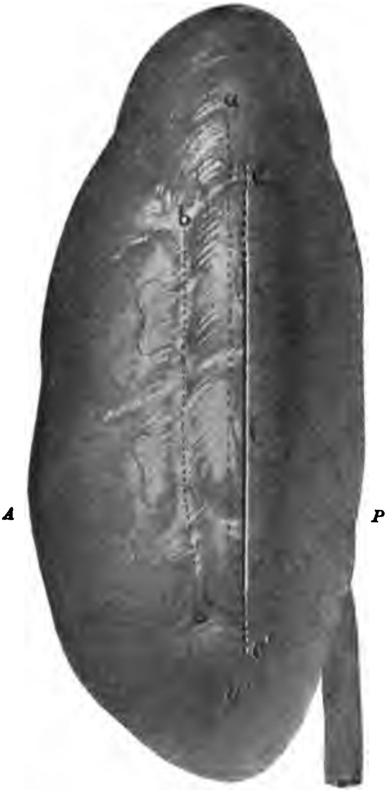
Fig. 181.



Lines of incision for operations on the kidney by the lumbar route. Heavy black line shows the usual incision. Dotted line indicates the prolonged incision for exploration when more room is needed or for operations on the ureter.

The kidney pedicle may previously be clamped either by the fingers of an assistant or by a padded clamp made for the purpose, but this is not essential. The incision should be large enough to permit the finger to be introduced into the pelvis. The cavity of the latter can now be thoroughly explored, and this exploration may be aided at times by a metal sound. This instrument, however, must be used with great care. Many surgeons still recommend—in place of incision—exploration of the kidney pelvis by means of puncture with a needle. Kelly advises distention of the renal pelvis by means of a ureteral catheter and an antiseptic solution before opening into its substance. Thus Brödel's line is made more prominent, and sacculations of the cortex may be more readily detected. The gush of fluid also denotes that the pelvis has been opened. The pelvis and calyces are explored by a stone searcher, such as is used for the exploration of the bladder of children. After exploration of the calyces and pelvis, the ureter should always be examined by means of a ureteral catheter.

FIG. 182.

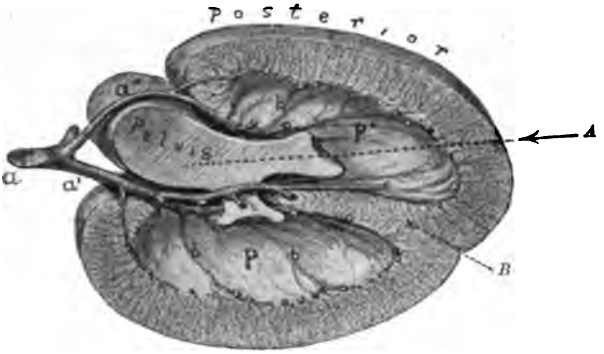


Lateral view of kidney. *b–b'*, Brödel's white line; *a–a'*, mid-line of kidney; *c–c'*, line of incision. (Brödel.)

The stone, having been found, is readily removed, provided it be small and fairly regular in shape. For this purpose either the scoop or forceps is employed. Branching, coral-like stones may require fragmentation. Stones deeply placed in the pelvis may be thrust up by pressure of the fingers working from the outside. Mortar-like concrements may be removed by the douche and scoop.

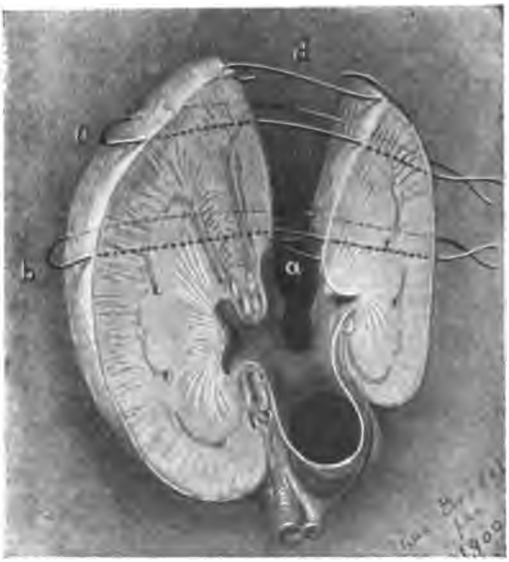
After extracting the entire calculus it is well to flush out the pelvis and calyces with a stream of normal saline solution flowing under strong pressure (eight feet) from a comparatively large nozzle. The kidney-wound is then sutured, usually by No. 2 mattress chromicized or iodized catgut passed through the capsule and kidney-substance down to the pelvis or the walls of a dilated calyx, but not including the mucous membrane. These sutures are tied down with moderate tension, and, providing they have been placed deeply, effectually stop bleeding. In the absence of renal infection, the kidney-wound is not drained. If the perinephric tissue has been widely separated to insert sutures, as in the treatment of floating kidney, the parietal wound is closed by careful suture of the muscles with chromicized catgut. A drainage-tube should be carried to the kidney-wound in the majority of cases.

Fig. 183.



A. The proper position for the incision. (Brödel.) *B*. Brödel's white line.

Fig. 184.



Method of suturing split kidney. (Brödel.)

When the secreting substance of the kidney has disappeared and is represented simply by a sac in which a large calculus is contained. nephrectomy is indicated. This, as a rule, should be performed as a second operation,—*i.e.*, some weeks or months after removal of the stone and after taking every means of making certain that there is practically no secreting kidney-substance left on the affected side, and that the other kidney is competent to act for both.

When infection has taken place, the parietal incision is the same as that for nephrolithotomy, but the incision into the kidney is made at the thinnest and most accessible portion of the tumor. Since infection is usually complicated by pyelonephrosis, there may be a large sac with diverticula, making the finding and removal of a stone extremely difficult. It is in these cases particularly that the sound is serviceable. It often happens that the calculi are either not found at all, or, if found, are only in part removed.

In the after-treatment of these wounds lumbar drainage is always indicated. Fistulæ are prone to persist in the track of the drainage-tubes.

As a means of surely removing the calculi and avoiding the persistence of fistulæ, primary nephrectomy has been proposed in cases of calculous pyonephrosis, particularly when the sac formed is large. The operative statistics scarcely justify this procedure, except when the kidney has become converted into a suppurating sac.

Nephrolithotomy performed before the advent of suppuration is attended by a mortality of less than four per cent. After suppuration the mortality is much greater, and a large percentage of cases are troubled by permanent fistulæ.

Duplay and Reclus particularly insist upon the importance of operating promptly in cases of calculous anuria. They hold that this complication is usually recurrent, since it is an almost certain proof of bilateral lesion. After a trial of prolonged hot baths, warm injections, abundant ingestion of diluents, massage of the ureter, the use of a continuous current of electricity, and profound anæsthetization, should anuria persist operation is indicated. Forty-eight hours should be the longest time allowed for these palliative measures. Calculous anuria is spontaneously relieved in twenty-eight and five-tenths per cent. of cases. Sixty-six and six-tenths per cent. of operative cases recover. (Legueu.)

The great difficulty in these cases is to discover the seat of obstruction: palpation, the history of the case, and ureteral catheterization and the X-ray may determine this. The incision should be the lumbar one, and the whole of the ureter should be exposed if this is necessary.

It frequently happens that persistent renal symptoms, particularly hæmaturia, pain, and recurrent colic, are entirely cured by nephrotomy, even though no stone or other cause for symptoms be found at operation. This is so well recognized that the operation is indicated by the wearing persistence of symptoms which do not yield to conservative treatment.

CHAPTER XVI.

SUPPURATIVE DISEASES OF THE KIDNEY.

THE suppurative diseases of the kidney may be arranged in two groups. In the first group belong those suppurations the microbes of which enter the kidney through the artery, vein, or lymphatic channels, or extend by contiguity from the perinephric tissue. In the second group are those suppurations which are due to ascending infection along the ureter.

Hæmatogenous infection of the kidney is nearly always secondary to pyogenic foci elsewhere. Jaffe reports five metastatic kidney abscesses in which the primary foci were furuncle, carbuncle, tonsillar abscess, and parotiditis. Either ulceration or internal suppuration may furnish the germs, but usually they are found in connection with general septicæmia, pyæmia, or ulcerative endocarditis. Exceptionally it is impossible to locate a primary focus; in such cases we must assume that micro-organisms circulating in the blood have attacked the kidneys first.

It has been conclusively shown that septic material ascending the vena cava may enter the kidney and produce suppuration.

Traumatic suppuration of the kidney, unless the result of a penetrating wound, must be classed with hæmatogenous infections, since, in the absence of bacteria, concussion or contusion of tissue cannot produce suppuration. It is evident, however, that the injury prepares a suitable culture-field for circulatory micro-organisms. In the traumatic cases but one kidney is usually affected, and there is frequently perinephric suppuration.

It is often impossible to distinguish between lymphatic infection and infection due to extension by contiguity. As causes of secondary infection may be mentioned appendicitis, perityphlitis, parametritis, caries of the vertebræ, sacrum, or pelvis, deep colonic ulceration, abscess of the liver or spleen, subphrenic abscess, and urinary infiltration (rare). All these inflammations may extend to the kidney, involving both this gland and its fatty capsule.

The micro-organisms commonly causative of renal suppuration are the bacterium coli commune, the staphylococcus aureus, the streptococcus pyogenes, and the proteus Hauseri. Exceptionally infection is due to the gonococcus, the bacillus typhi, the diplococcus pneumoniæ, the tubercle bacillus(?), actinomyces, and the micro-organisms of acute infectious diseases. It should be borne in mind that pyelitis is common in the course of the various infectious diseases, and may become membranous.

Several important facts must be emphasized in relation to the renal suppurations which result from ascending infection. Obstruction in the urethra, bladder, or ureter which interferes with the outflow of urine produces conditions very favorable to infection, though it will not in itself cause suppuration. An aseptic ligation of one ureter causes atrophy of the kidney, but a septic ligation gives rise to suppuration. Traumatism, alteration in the character of the urine, or the elimination of irritating drugs, such as cantharides, produces congestion, but never septic inflammation. All causes which occasion acute or chronic congestion predispose to infection.

Clinically, obstruction and the consequent alterations in the urine are the conditions which most frequently render the kidney and its excretory channels favorable culture-media for pyogenic micro-organisms. As a rule, the healthy mucous membrane of the uro-genital tract resists septic infection, but it will not always do so, nor is it necessary that there should be obstruction in order that septic matter in the bladder may enter the ureters and ascend into the pelvis of the kidney. It has been experimentally shown (Lewen and Goldschmidt) that substances introduced into the normal bladders of animals may ascend to the kidneys. It is probable that under certain circumstances intestinal bacteria may obtain an entrance into the kidneys without any discoverable break in the continuity of the tissues.

Micro-organisms are, then, the invariable causes of renal suppurations, and the clinical causes of congestion can do no more than make the tissues susceptible. While it is true that individual susceptibility and local predisposition render one person more liable to suppuration than another, it must not be forgotten that bacterial virulence may be so pronounced that the most healthy tissues cannot resist infection.

The methods by which bacteria may reach the kidneys from below are—through the urine by means of antiperistaltic movements of the ureters; by extension along the mucous membrane or the lymph-channels of the ureters; by penetration into the pelvis or ureter from the tissues surrounding the urinary tract (either by a rupture of an abscess into the pelvis or the ureter, or by emigration of the micro-organisms through the walls).

The clinical causes of spontaneous suppuration of the kidney are—the acute infectious diseases, exposure to cold and wet, traumatism, stricture of the urethra, enlargement of the prostate, tuberculosis or malignant disease, gout, irritation from drugs, such as turpentine or cantharides, and renal calculus. Age, sex, and occupation affect the development of suppurative kidney disease only so far as they are associated with predisposing causes. Thus, pyelitis is common in old men because of prostatic enlargement, and in young women because they frequently suffer from parametritis.

In accordance with its location and clinical course renal suppuration is termed pyelitis, pyonephrosis, pyelonephritis, and suppurative nephritis.

Pyelitis, or inflammation of the kidney pelvis, may be secondary to nephritis (descending), or to ureteritis (ascending), or rarely to perinephritis (contiguity); the ascending inflammation is the common form.

The most frequent predisposing and exciting causes of pyelitis are —(*a*) the infectious diseases; whether in these cases the local inflammation is due to toxins or to alterations in the urine has not been determined; (*b*) traumatism, a rare but undoubted cause; (*c*) exposure to cold; (*d*) drug irritation, as from the irritating diuretics, the balsams, the ethereal oils; (*e*) nephritis, particularly the interstitial nephritis of the gouty; (*f*) venous congestion, due either to general stasis or to local stasis, as in chronic valvulitis, pregnancy, floating kidney, abdominal tumor; (*g*) perinephric inflammation; (*h*) mechanical irritation of gravel or calculus; (*i*) tubercle, malignant disease, parasites; (*j*) and, most important of all, cystitis, particularly when it is associated with obstruction.

Pyelitis is usually bilateral. It varies in degree from a superficial catarrhal inflammation to a deep infiltrating destructive process. In the absence of infection there is often a congestion of the mucous membrane of the pelvis unassociated with desquamation of epithelium or suppuration. Such a condition may be caused by irritating conditions of the urine.

Catarrhal pyelitis may be acute or chronic. In the acute form the mucous membrane is swollen and congested; there are patches of desquamation; in severe cases the surface is covered with thick mucus mixed with blood, in which the crystals of the urinary salts are deposited. In chronic pyelitis the mucous membrane is dark in color, there is a serous infiltration of the submucoid tissues, with interstitial overgrowth, many small mucus-cysts may be formed, and in some cases the lymph-follicles become much enlarged and prominent (pyelitis granulosa). The surface is generally covered with a tenacious altered mucus, and there is general desquamation of epithelium. Ulceration may be present, which may extend through the coats of the pelvic wall, giving rise to abscesses or even to infiltration of urine. Any pyelitis may become membranous, particularly when ammoniacal fermentation has taken place. Indeed, a strictly catarrhal pyelitis is quite rare.

When the pus of pyelitis blocks a ureter, pyonephrosis or pyelonephritis results. Parenchymatous, or more commonly interstitial, nephritis is frequently caused by pyelitis; the contracted kidney of pyelitis, however, differs from a primary contracted kidney in that the preponderance of fibrous overgrowth is in the medullary substance instead of in the cortex. Amyloid degeneration may occur in one or both kidneys when suppuration is profuse and long continued.

Symptoms.—In many cases, as is evident from the list of causes, the symptoms of a pyelitis are lost in those of the antecedent disease. In simple congestion of the pelvis pain in the loins and frequent urination are the only symptoms.

In acute catarrhal purulent pyelitis the pain is often severe, and may present acute exacerbations; the kidneys are tender on pressure, and frequency of urination is marked. The quantity of urine is usually decreased, and exceptionally reflex anuria may supervene. The pain is increased by motion, by deep respiration, or by coughing, and may be reflected down into the penis and testicle or up towards the shoulder.

Vomiting is not uncommon. Fever develops, and there may be chills followed by profuse perspiration. As a rule, the kidneys, though tender, are but little enlarged in acute pyelitis.

The urine is generally acid, and contains a trace of albumen, degenerated epithelium, hyaline casts, and often pus and blood.

Acute pyelitis and pyelonephritis, due to the colon bacillus, are common, though usually overlooked in infancy; pyuria of non-vesical origin, renal tenderness, chills, fever, and gastro-intestinal disturbances are characteristic symptoms.

In chronic pyelitis the symptoms are usually less pronounced. The pains are not so marked, nor are the glands so tender on pressure. Fever, if present, is likely to be intermittent. The kidney is not palpably enlarged unless there is pyonephrosis. There is a general impairment of health.

The urine is increased in amount, is acid or neutral, and contains nucleo-albumen, pus, and epithelium in abundance; blood is rare. As in the acute form, hyaline casts are common, but in a pure pyelitis granular casts are rarely seen. If only one kidney is affected, there may be periods when, owing to obstruction of the diseased pelvis, the urine will be normal. Calculi not infrequently form in chronically inflamed pelves. Many cases of chronic pyelitis are overlooked till irremediable kidney disorganization has occurred.

Diagnosis.—Pyelitis must be distinguished from renal and from vesical inflammation. In pyelitis the albumen is dependent upon the blood and pus, in nephritis it is essential. Granular casts are usual in kidney disease, they are not found in pyelitis. The large amount of nucleo-albumen is quite distinctive of pyelitis. The leucocytes in the urine of nephritis are often mononuclear, those of pyelitis are polynuclear. The pain of nephritis is insignificant, while acute severe pain occurs in nearly all cases of pyelitis.

Cystitis suppurates more freely than pyelitis, and the urine is more likely to be alkaline and contains a much smaller percentage of albumen (one-tenth per cent. as contrasted with three times as much in pyelitis. Rosenfeld). A cystoscopic examination will prove the presence of inflammation, and ureteral catheterization will show that the urine contains no pus till it reaches the bladder. Such an examination may be required before the origin of pus can be positively determined. The importance of this becomes evident when it is realized that in the absence of ureteral obstruction polyuria and pyuria are the most constant and reliable signs of chronic pyelitis. Bazy regards nocturnal pollakiuria as the most important of all signs for the differentiation of pyelitis.

Prognosis.—Acute congestion and chronic congestion of the kidney pelvis are dangerous only because they predispose to infection. Acute catarrhal or purulent pyelitis is generally self-limited unless the infection has spread to the kidney-substance, the period of disease varying from a few days to a few weeks. The prognosis and duration of chronic pyelitis depend obviously upon the cause. When the disease develops without appreciable cause, or when it is associated with incurable obstruction or an inveterate gouty diathesis, the prognosis must be guarded.

Treatment.—The treatment of pyelitis varies in accordance with the cause, and is also dependent in a measure upon the character of the inflammation. Slight cases, such as those which develop after the exanthemata, are treated by rest, liquid diet, and the ingestion of diluents. The natural tendency of this form of inflammation is towards recovery. When the symptoms are sufficiently severe to excite some constitutional reaction and to cause local pain, counter-irritation, local depletion, hot baths, the administration of soothing or stimulating diuretics, and careful attention to the condition of the skin are indicated. Pain should be relieved by morphine given hypodermically. Inflammation due to mechanical causes, such as calculus or stricture, prostatic enlargement, or any obstruction to the free flow of urine, can be cured only by surgical intervention. Should this become necessary in the course of acute pyelitis, it must be borne in mind that there is always great danger of converting a simple pyelitis into a pyelonephritis or "surgical kidney;" hence every antiseptic precaution should be taken.

If the bladder be the seat of inflammation, vigorous treatment of the cystitis may effect a cure. Cabot has pointed out the value of permanent catheterization.

The operative procedures should be preceded by the administration of urinary antiseptics,—namely, salol and boric acid; urotropin or benzoic acid should be given when the urine is alkaline.

The development of pyelitis as a complication of any obstructive lesion of the urinary tract, regardless of its seat or cause, is a sufficient ground for operative interference when this offers any promise of permanently overcoming the obstruction. The operation should be performed early, since pyelitis associated with obstruction means inevitable destruction of the secreting substance of the kidney.

Kelly, Pawlik, and others have treated chronic pyelitis by the mouth administration of urinary antiseptics (salol and urotropin) and diluents, and by drainage, instillation, and irrigation. This treatment, particularly indicated in cases dependent upon ureteral strictures, has also been efficient in those cases developed as a consequence of hæmatogenous or of ascending infection; in the latter case only after the cure of the lesions of the lower tract. Protargol, in one to five per cent. solution, is used for instillation, the same drug, 1 to 2000, or boric acid, 1 to 500, for irrigation, the treatments being repeated twice weekly till pus has disappeared from the urine. Thereafter prolonged dietetic and hygienic treatment is indicated. When a chronic pyelitis persists, as shown by urinary examination and renal and gastro-intestinal symptoms, in spite of a careful dietetic and hygienic regimen supplemented by diluents and urinary antiseptics given in such doses as not to disturb the stomach, nephrotomy is indicated. This is performed by the lumbar route, the renal pelvis being opened through the avascular zone of the kidney-substance. Mechanical causes of obstruction are sought for and removed, and the pelvis is irrigated and drained through ureteral catheters.

Pyonephrosis.—When in the course of pyelitis the ureter becomes blocked, pyonephrosis develops. The same condition is produced by infection of hydronephrosis. The pelvis becomes rapidly distended, and ulceration and dilatation of the calices occur. When the condition is permanent the entire kidney is riddled with abscesses. The obstruction is usually incomplete.

The pelvis may rupture early; later rupture may take place through the cortex; in either case there results a perinephric abscess. Exceptionally pus may become inspissated, and extreme contraction of the kidney occur. Pyonephrosis may give rise to general metastasis, but this is rare. Occasionally the kidney forms adhesions to neighboring organs and may rupture into them.

Symptoms.—In cases which follow the blocking of a ureter the first symptom is usually pain, which may be colicky, and is made worse by pressure anteriorly, but is often relieved by pressure posteriorly. Fever with chill will likely be the first symptom in a case in which suppuration occurs in a hydronephrotic sac. The quantity of urine bears some ratio to the retention; in a few cases anuria is produced by reflex inhibition, though this is usually due to defect or absence of the other kidney.

A tumor may form in the loin, tender on pressure, fluctuating in most cases, but sometimes doughy, and projecting into the abdominal cavity. The tumor is often not perceptible. It will be dull on percussion in the flank, but the presence of the overlying colon generally suffices to make the note on abdominal percussion resonant; alternate emptying and filling of the colon with air or liquid may aid in establishing a diagnosis.

If the pyonephrosis is unilateral, pus may disappear from the urine at times; if bilateral, the pus may be reduced in quantity; but it is a clinical fact that in some cases little apparent change occurs in the quantity of pus contained in the urine.

The variations in the quantity of pus in cases of pyelitis are sometimes marked, so that a sudden reduction of pus in the urine does not imply obstruction unless it is coincident with a reduction in the quantity of urine. If the obstruction is permanent and the other kidney is able to compensate, the quantity of urine will gradually rise to the normal. Irregular fever, with a high evening rise, chills, and the constitutional symptoms of internal suppuration are present in most cases, but some run their course with few or no general symptoms.

Diagnosis.—The diagnosis of pyonephrosis is founded upon the presence of a tumor in the region of the kidney and on intermittent pyuria. The tumor cannot always be felt, since distention may take place upward towards the diaphragm. When perceptible it is rounded in form, obscurely fluctuating, and tender on pressure. A pathognomonic characteristic of the tumor is its variation in size, dependent upon temporary relief of obstruction and escape of the purulent urine contained in the kidney pelvis. This symptom is closely related to intermittent pyuria; when the pelvis of but one kidney is affected, the other remaining healthy, there may be periods when the urine is absolutely normal, followed by periods during which there is marked polyuria, the urine containing a large quantity of pus.

Rayer states that pyonephrosis must be distinguished from morbid enlargements of the spleen, liver, and gall-bladder, from renal tumors due to causes other than pyonephrosis, such as hydronephrosis, hemorrhage, cancer, tubercle, or cysts, from renal abscess, from tumors of the suprarenal capsule, from aortic aneurism, and from fæcal impaction.

A differentiation from hydronephrosis or perinephric abscess is often difficult. Hydronephrosis is unattended by fever, and there is usually but slight pain; continuous or intermittent pyuria is absent. Perinephric abscess is characterized by severe pain, rapid extension of the tumor, marked constitutional symptoms, extreme local tenderness, and often œdema and superficial fluctuation. The urine may or may not contain pus; the thigh is often flexed upon the abdomen. At times a distinction cannot be made. This, however, is not a matter of great importance, since the three conditions, pyonephrosis, perinephric abscess, and hydronephrosis, practically require the same treatment.

The distinction of pyonephrosis from aortic aneurism is of great importance, since were aneurism present an incision for nephrotomy might result fatally.

Treatment.—Pyonephrosis, dependent as it necessarily is upon infection and obstruction, is amenable only to mechanical treatment. Ureteral catheterization when successful will relieve tension, and hence stop septic absorption, and may in some cases prove curative by enabling the surgeon to evacuate the pus and to treat the renal pelvis by direct instillation and irrigation. When this procedure is inapplicable, operation is indicated.

When there is marked narrowing or complete blocking of the excretory channels, associated with constitutional symptoms of septic absorption, operation is imperatively indicated, since there is danger of purulent infiltration and destruction of the secreting portion of the kidney, and long-continued suppuration is likely to produce amyloid degeneration of the opposite kidney. When both kidneys are diseased, nephrectomy is inadmissible, even should this be indicated by the extent of local infection. It happens at times that, as a result of non-interference and because of complete ureteral obstruction, the kidney atrophies, the pus which it contains becomes caseous, and there is thus effected a species of spontaneous cure.

The operative treatment may take the form of aspiration, nephrotomy, or nephrectomy.

Aspiration gives temporary relief, and is exceptionally followed by cure, since, as the result of relief of tension and consequent congestion, the obstruction is overcome and the secretion of the kidney is again poured into the bladder. Usually a more radical method of treatment will be required.

Nephrotomy consists in exposing the kidney by the ordinary lumbar route, opening the pelvis through the parenchyma, evacuating the pus and urine, and removing calculi if these are present. The ureters should be explored, and obstruction should be remedied by appropriate treatment. The perinephric tissues are thoroughly cleaned and drained by gauze, the suppurating cavity is packed with gauze, and a thick, absorbent dressing is applied, the patient being placed on an oakum mat. In twenty-four hours the gauze packing in the pelvis of the kidney is replaced by a large drainage-tube, and the perinephric packing is removed, with the exception of two or three small strips.

Nephrectomy may be performed as a primary operation when the kidney has been converted into a thin, pus-containing sac which is not very adherent. The adhesions are often dense, sometimes insurmountable. It has happened to a surgeon as experienced as Billroth to tear the vena cava and lose his patient from hemorrhage in the effort to remove a pyonephrotic kidney. It is safer to postpone total removal till it has been proved that nephrotomy and drainage are insufficient to cure. The mortality of secondary operations is lower than that for primary nephrectomy in this class of cases.

Duplay and Reclus collected one hundred and six cases of nephrotomy performed for suppurative disease of the kidney (pyelitis); the mortality was thirteen and three-tenths per cent. The mortality of nephrectomy is estimated at thirty-seven and five-tenths per cent. They state that, even when patients are profoundly cachectic, operation and drainage may prolong life for several years. This result is due not only to suppression of the infecting focus from which are absorbed toxins, but also to a physiological action which is well confirmed. After free drainage, portions of the kidney which remain intact are able to resume their excretory function. After nephrotomy a fistula persists in about forty-five and six-tenths per cent. of cases.

This is often due to long postponement of the operation. In secondary nephrectomy for pyelitis the mortality in twenty-four cases was five and nine-tenths per cent.

Pyelonephritis.—This term signifies septic inflammation of the kidney secondary to pyelitis. It is the ascending form of renal suppuration. The descending form is best known as suppurative nephritis.

The predisposing and exciting causes of pyelonephritis are the same as those of pyelitis and pyonephrosis. It is merely a more extensive and more dangerous stage of pyelitis, and an almost unavoidable complication of pyonephrosis. The infection extends from the calices into the uriniferous tubules, involving the parenchyma of the kidney, and converting the organ into a mass of small abscesses, or perhaps one large suppurating sac. The name "surgical kidney" has been applied to this form of suppurative disease, because it has been so frequently produced by the use of infected instruments.

Pyelonephritis is apt to develop rapidly when decomposing urine is retained in the pelvis; it may be caused by extension of inflammation in the absence of retention.

In the early stages of pyelonephritis the cortex of the kidney is thin, and the capsule is adherent to the surface and to the renal tissue. When it is stripped from the kidney numerous small abscesses are opened; the kidney is swollen, soft, and congested. Section shows yellow streaks, the distended straight tubules running from the cortex to the pyramids. Between these streaks the renal substance seems to be healthy. The pelvis is congested, and exhibits patches of ecchymosis, or even of ulceration. Instead of small suppurating foci, large abscesses may form, and break through the kidney capsule.

Microscopically, the straight tubules are dilated, distorted, and filled with epithelial débris, pus, urinary salts, and micro-organisms. The veins are also distended with partially coagulated blood and pus. This is in marked contrast with pyæmic processes, in which the blood-clot and pus-formation take place within the arteries. The Malpighian bodies and convoluted portions of the tubules become obliterated. The fatty capsule is infiltrated, tough, fibrous, and adherent in chronic inflammation, or it may become infected and suppurate.

The colon bacillus is the usual microbic cause of an ascending pyelonephritis.

Symptoms.—Pyelonephritis may assume the acute or the chronic form. The acute form is characterized by the sudden onset of a chill, followed by high fever, and accompanied by severe pains in the loins. There is often delirium, and the fever may rise to 106° or 107° F., or even higher.

Usually the fever is continuous, with remissions. The patient passes into a typhoid state; the tongue is dry and heavily coated; there are rapid emaciation, often an extremely irritable condition of the stomach, and drenching sweats. There may be persistent vomiting and hiccough. Mental dulness, semi-consciousness deepening into coma, and finally death, follow.

The disease is usually rapidly fatal, terminating in about ten days or two weeks.

It is obvious that symptoms of acute pyelonephritis are due in part to septic intoxication, in part to uræmia. All cases do not end fatally. The fever may gradually grow less, the stomach become retentive, and a return to comparative health follow. In such cases it seems probable that the pus has been so placed as to be well drained into the ureter, or that it has become caseous and encysted, the secreting substance of the one kidney having been destroyed, and the remaining kidney having assumed double duty.

With the lessening or disappearance of fever the return to health is the exception, not the rule. The pyelonephritis is more likely to become chronic. In this form of inflammation the temperature may be normal. Commonly it is slightly and persistently elevated.

Rayer long ago pointed out that the chief symptoms of chronic pyelonephritis are often those of gastro-intestinal irritation. These are chronic dyspepsia, a dry brown tongue, secretion of saliva so scanty that solid food is refused, constipation, often tympany, sometimes uncontrollable diarrhœa. The patient is usually extremely weak and depressed, and sleeps badly. These symptoms gradually become more marked, and progressive emaciation, extreme susceptibility to local congestion from exposure to cold, and frequently intercurrent febrile attacks, develop. The symptoms are due to uræmia and infection combined. Locally there may be neither pain nor tumor, and the patient may be unaware of any urinary trouble.

Diagnosis.—This is based upon the presence of pus in the urine, pain and tenderness in the region of the kidney, the presence of a tumor, and the development of an otherwise inexplicable gastro-intestinal catarrh. In the absence of pyonephrosis, there are usually polyuria and constant pyuria. Oliguria is an ominous sign. The urine is alkaline. Microscopic examination shows hyaline casts and sometimes fragments of renal tissue. Exceptionally there is slight hæmaturia; rarely the bleeding is free: this is usually due to calculus. There may be absence of both spontaneous and provoked pain. There is frequent, often painful, urination, especially during acute exacerbations of the chronic inflammation. When pyelonephritis is complicated by pyonephrosis there is also the development of a swelling which may exhibit variations in size; if but one kidney is affected there may be intermittent polyuria and pyuria.

The diagnostic characteristics of pyelonephritis are pyuria and symptoms of septicæmia.

The differential diagnosis of chronic pyelonephritis from cystitis may be extremely difficult. Cystitis, however, does not produce the constitutional symptoms, and ureteral catheterization will show the absence of pus from the urine as it escapes from the kidneys. Cystitis and pyelonephritis are often associated. In such cases ureteral catheterization, by showing that pus comes from the kidney, is again serviceable; moreover, fever, rapid deterioration in health, and pronounced gastro-intestinal symptoms are in themselves sufficiently characteristic of the kidney affection.

The symptoms of renal tuberculosis are similar to those of pyelonephritis. Tubercular family history, the presence of tubercular infection in other portions of the genito-urinary tract, and the finding of the Koch bacillus will point to the nature of the disease. There is often mixed infection in tubercular nephritis.

It is important to find out whether both kidneys are affected. This will be determined by the results of palpation and ureteral catheterization.

Intermittent pyuria necessarily points to the existence of one healthy kidney. Hypodermic injections of methyl-blue are sometimes useful in determining renal permeability. Healthy kidneys eliminate this drug partly unchanged and partly in combination rapidly, unintermittently, and completely. When the kidneys are diseased the elimination is slow and intermittent. When it is important to know whether one or both kidneys are diseased, this may be determined only by ureteral catheterization or the use of the segregator.

Treatment.—The preventive treatment of pyelonephritis is particularly important. In view of the fatality of this affection, it is impossible to express too emphatically the necessity for asepsis even in so trivial an operation as catheterization, especially when after chronic retention the urinary tract is predisposed to infection.

When pyelonephritis has developed it should be treated as a combination of uræmia and septicæmia. Liquid diet, particularly milk, the administration of diuretics and of diluents, counter-irritation over the kidneys,—in acute cases by dry cups followed by hot fomentations,—and the administration of laxatives, are indicated as the means of combating uræmia. Since septicæmia causes death by exhaustion, the administration of alcohol well diluted and of as much nourishment as can be assimilated is desirable. Quinine should be avoided, since it is useless in small doses, and in full doses markedly congests the kidneys. Small doses of salol and boric acid are serviceable, since they tend to prevent ammoniacal fermentation in the kidney pelvis.

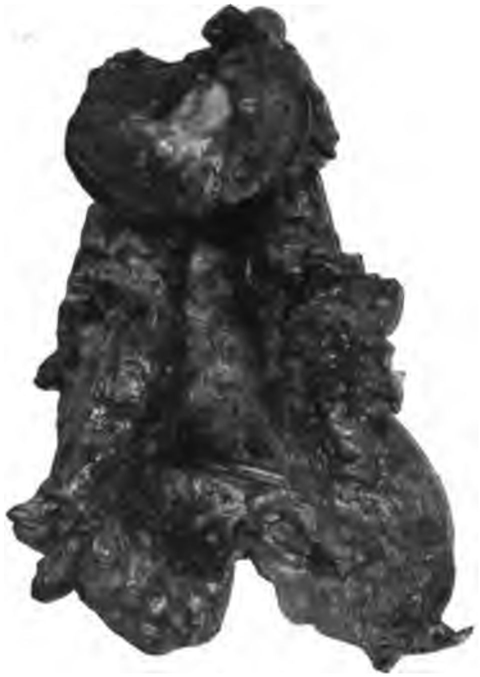
When pyonephrosis develops in the course of pyelonephritis, or, even in the absence of this, if symptoms are progressive, nephrotomy with free drainage is indicated. The kidney should be opened into the pelvis on its convex border, and the examining finger should discover and break into every pus-collection of appreciable size. Theoretically nephrectomy is indicated, since the kidney is often riddled with multiple abscesses ; the infection is, however, frequently bilateral. When after drainage the symptoms do not improve and there is a free discharge of pus through the lumbar wound, a secondary nephrectomy may be performed if repeated examinations have shown that the other kidney is normal. The degenerated fatty capsule is in chronic inflammations often adherent to the kidney capsule proper, and to surrounding organs and structures, rendering enucleation of the kidney a difficult and dangerous procedure. The nephrectomy should then be accomplished by decortication, the kidney being shelled from its proper capsule, and a pedicle being formed at the expense of a portion of its substance about the hilum.

Suppurative Nephritis.—Under this heading are classified renal suppurations in which the agents of infection enter the kidneys through its vessels, through its lymph-channels, or by contiguity. Such suppurations are seen in pyæmia, in endocarditis, and in the acute infectious fevers, as the result of extension of infection from adjacent tissues, or in consequence of traumatism or exposure to cold.

In hæmatogenous infections the condition is usually bilateral, though embolic infection may occur in but one kidney. The abscesses are generally multiple ; single large abscesses are occasionally seen. The hæmatogenous abscesses first form in the cortex ; from these the entire gland generally becomes infected. The abscesses may coalesce, and in some cases renal disintegration goes so far that nothing remains but a sac (the capsule) filled with pus. In non-hæmatogenous suppuration the process may commence in any part of the kidney, according to the origin of infection. The abscesses may rupture into the pelvis or through the capsule, with the production of perinephric suppuration. It is in suppurative nephritis that metastasis most often occurs.

When the kidney infection is simply an expression of a general pyæmia the suppuration is rarely extensive; small abscesses form about the glomeruli and the smaller vessels of the cortex of both kidneys, often with blocking of the uriniferous tubes. The renal substance is the seat of a parenchymatous inflammation. In rare cases of long duration amyloid degeneration may occur.

FIG. 185.



Complete destruction of kidney by an abscess. Small supernumerary kidney above. (From a patient in the University Hospital.)

Symptoms.—When suppurative nephritis complicates pyæmia the symptoms are often masked by those of the general disease; sometimes patients complain of violent pains in the loins, and not infrequently a marked oliguria (or even anuria) occurs. Blood and hyaline casts may be present in the urine.

Fever of a hectic type develops in nearly all cases, and chills occur irregularly. Violent attacks of hiccough and vomiting are sometimes noted; these are probably uræmic. There are generally lumbar pains, severe prostration, and the rapid development of a typhoid state, the sensorium becoming clouded, and the patient dying with symptoms of both pyæmia and uræmia. Typical uræmia with convulsions has been noted in a few cases.

The urinary changes are not constant. In some cases there are no alterations other than oliguria. A little blood and a few hyaline casts are often found on microscopic examination. Later in the disease granular casts give evidence of parenchymatous degeneration. Pyuria, especially if profuse, indicates that an abscess has been evacuated into the pelvis; this may be followed by marked amelioration in the general condition. In rare cases pieces of renal tissue may be voided.

Diagnosis.—Since enlargement of the kidney is usually slight, suppurative nephritis will not ordinarily be confused with the extrarenal suppuration. The course of suppurative nephritis is too acute for neoplasms; hydronephrosis, pyonephrosis, and perinephric abscess generally occasion much more marked enlargement. The careful examination of the urine, the history of the case, and exploration of the lower urinary tract will usually lead to a diagnosis. Renal suppuration, unless well drained, causes a circulatory leucocytosis.

Treatment.—This is at first expectant and symptomatic. The patient is kept absolutely at rest, and careful attention is paid to the constitutional condition. If the abscess can be clearly located, or if the symptoms are pronounced and progressive, exploratory nephrotomy should be performed. It is often the case, however, that symptoms pointing to the exact location of the abscess are masked until the condition of the patient will not admit of an operation. When suppurative nephritis develops in pyæmia it is a local expression of the general condition to which treatment is mainly directed.

Perinephritis.—Perinephritis is, strictly speaking, an inflammation of the fibrous capsule; the term, as commonly used, implies inflammation of the fatty capsule. Inflammation of the true capsule occurs in nearly all renal diseases. It is frequently sclerotic, thickened, and adherent to the gland; it may suppurate secondarily to adjacent renal suppuration, or it may become involved in tubercular and malignant processes.

Beyond the evidences of the renal or perirenal disease which causes it, true perinephritis presents no symptom except pain. It seems clearly established that inflammation of the true kidney capsule causes more pain than involvement of the secreting portion of the kidney.

Inflammation of the fatty capsule of the kidney is very common, since this tissue possesses a low degree of power of resistance to infection.

Perinephritis is not necessarily suppurative. After a long-lasting nephritis it sometimes happens that the capsule of the kidney is converted into a dense fibrous investment, the fat having almost entirely disappeared, or the fatty envelope of the organ may be greatly thickened, showing an increase of both adipose and fibrous tissue. This overgrowth is particularly abundant about the hilum, and much resembles in structure lipomata occurring in other portions of the body.

There are two forms of perinephric abscess: the primary, in which the suppuration arises *de novo* in the fatty capsule; and the secondary, in which the primary focus lies elsewhere.

The primary forms of perinephric abscess may arise in several ways. Traumatism is responsible for some cases. In injuries to the lumbar region when there is penetration, laceration, or cutaneous abrasion, pyogenic micro-organisms have direct access to the tissues, and infection may follow; but there have been cases of perinephric suppuration following traumatism in which no superficial injuries occurred. The rare instances in which such suppuration has followed severe jarring to the trunk or heavy lifting must be classed with the primary cases. Many cases have been attributed to colds. The infection must be explained in one of several ways: it may have been hæmatogenous, the traumatism or the cold having rendered the tissues susceptible to the circulatory micro-organisms; or the traumatism may have excited to activity a latent disease. There may also be a perinephritis due to actinomycosis.

The secondary perinephric suppurations arise from many causes. From the kidney secondary infection is common. In any case of suppurative nephritis, pyelonephritis, pyonephrosis, hydronephrosis, pyelitis (especially associated with calculus), ureteritis, tubercular, malignant, or cystic disease, a perinephric abscess may form. The infection may be due either to the rupture of an area of renal suppuration into the perinephric tissue, or to extension through the true capsule without discoverable opening. The infection may reach the fatty capsule from its periphery. Thus, perityphlitis and appendicitis, parametritis and parovaritis, malignant disease of the colon, abscess of the spleen, gall-bladder, or liver, subphrenic abscess, psoas abscess, or any bone suppuration, and in rare cases abscess of the lung or pleura, may be the primary focus of suppuration.

In other cases infection may reach the fatty tissues by the blood- or lymph-channels. In pyæmia or internal suppuration, in puerperal fever, or after operations on the prostate, bladder, testicles, rectum, or ischiorectal spaces, such an infection may occur. Finally, there are rare instances of perinephric suppuration entirely without obvious cause, in which an infection by micro-organisms from the colon may be possible. The condition is most common in men (of one hundred and thirty-eight cases collected by Nieden ninety-seven were in men). Most of the cases have occurred in middle life, but there have been cases in children (one at five weeks) and in persons over sixty years. The right side has been found more often affected, and in at least two instances the condition was bilateral. The abscesses may be large or small, single or multiple. The latter condition is most often seen in cases where infection has proceeded from the kidney. The pus may spread from the fatty capsule and infiltrate the loose retroperitoneal tissue; in other cases it is walled in by a strong fibrous capsule. The perinephric lipomatous investment is more or less necrotic, and bleeding is not uncommon in the infected area. The pus is usually bland and odorless; it may, however, be fetid (intestinal infection?), or urinous. According to its origin the pus may contain renal tissue, concretions, parasites, or shreds of neoplasm. The kidney-substance often becomes secondarily involved, and amyloid degeneration may ensue. Metastasis to distant organs is rare.

The main portion of the abscess is usually placed directly behind the kidney, but the pus may burrow in various directions, and this tendency is of great clinical importance. It may descend into the pelvis behind the peritoneum, opening into the rectum, vagina, urethra, or bladder (in about four per cent. of recorded cases). It may pass down within the sheath of the psoas muscle and point below Poupart's ligament, may follow the iliac vessels and point in the femoral region, or may pass out through the sacro-sciatic foramen and point in the gluteal region. Rupture into the ureter or the kidney is possible. In a few cases the abscess has discharged into the colon (of six cases, four recovered), duodenum, or stomach; the liver may be secondarily infected. Rupture into the peritoneal cavity is rare, as the peritoneum becomes thick and fibrous as a result of inflammation. The upward pressure of an extensive perinephric abscess may be sufficient to cause distressing dyspnœa.

Perhaps the most frequent direction of pointing, with the exception of those abscesses which open in the lumbar region, is towards the pleural cavity. Senator long ago called attention to the existence of a serous pleurisy which often complicates perinephritis, even though the abscess has not directly involved the pleura. It has been shown that there is a triangular defect in the diaphragm just behind the upper portion of the kidney: hence there is little to prevent the extension of pus upward when the perinephric tissues suppurate. After rupture through the diaphragm the pus may infiltrate the retropleural tissue, penetrate the pleural cavity, causing empyema, or rupture into the lung, giving rise to pulmonary abscess. In some cases profuse purulent expectoration or the symptoms of suppurative pleuritis first attract attention to the perinephric suppuration, though, unless it is remembered that perinephritis may be a causative factor, the etiology of the pulmonary abscess or the empyema may remain unsuspected. In Fisher's series of ninety-four cases the pleura was affected in twenty-four per cent., the lungs in twenty per cent., and the pericardium in six per cent.

Symptoms.—The cardinal symptoms of perinephritis are tumor, pain, tenderness, and fever. The local symptoms depend upon the formation of pus and the direction of its extension. In the cases which are secondary to inflammation of the appendix, the uterus or its adnexa, the gall-bladder, etc., the symptoms of perinephritis are masked by those of the original disease. This is also true of suppuration secondary to infection of the uro-genital tract or which occurs in the course of a general pyæmia.

The symptoms are clearly marked in cases following traumatism or cold or in those of hæmatogenous origin unassociated with general pyæmia. Pain, chill, and fever are generally the early phenomena.

The pain is at first confined to the loin and aggravated by pressure; soon any motion of the trunk or leg of the affected side greatly increases it. The patient lies on his back, with a lateral curvature the concavity of which is towards the side involved; the thigh is adducted and flexed. At times severe pains may radiate into the genitalia, around the abdomen, or into the thigh; this is due to pressure upon the nerve-trunks. Even in the feverless walking cases the muscles attempt to protect the inflamed region; the thigh is adducted, the body is bent forward, and the trunk is fixed, usually with a lumbar flexure towards the inflammatory focus; the patient limps. In a few cases partial anæsthesia and paresis have been noted. Since the third and fourth lumbar nerves supply the muscles which flex the thigh, this symptom of flexion is most prominent where the abscess lies directly over them,—that is, about the lower third of the kidney. In some cases the thigh is fixed in flexion; in other cases any motion except extension may be performed painlessly.

The fever may be high or moderate; it is usually markedly intermittent or even remittent, and often presents the distinct hectic type. Chills and profuse perspiration are common. The blood generally shows leucocytosis, except when the condition is secondary to bone tuberculosis. The gastro-intestinal tract is deranged, there are anorexia, vomiting, sometimes tympany, and these disturbances may be much aggravated by the pressure of the abscess upon the colon, with the production of obstruction and consequent stercoræmia.

The local symptoms develop early. There is a tender tumor in the loin, which may be indistinctly fluctuating and irregular in outline. The abscess lies under the colon, and therefore usually does not produce an area of dulness on anterior percussion, but flatness is marked in the lumbar region.

The loin is usually swollen; this swelling may be so slight that careful measurements are necessary to demonstrate it, or it may be so distinct that the lumbar region protrudes. This tumor does not move with respiration. When external pointing is about to take place, the skin over the loin becomes red and waxy, and distinct œdema develops; the abscess usually opens in or near Petit's triangle.

Supradiaphragmatic symptoms often develop. Independent of perforation into the pleura, severe pleurisy may occur, presenting the recognized symptoms of that condition. In nearly all cases there is restricted abdominal breathing, and hence some dyspnœa and an irritable cough. Apart from diaphragmatic rigidity, extreme dyspnœa may be produced by direct pressure of a large abscess.

In the acute cases the general strength of the patient is quickly and markedly reduced, prostration is extreme, and, unless there is natural or artificial evacuation, the patient becomes profoundly septicæmic, or even may succumb to a general pyæmia. The tubercular cases, however, and some of the infective cases, run a mild chronic course, in which the local phenomena largely predominate.

When the abscess forms visceral adhesions, or shows a tendency towards pointing externally, additional symptoms usually appear, though evacuation may be accomplished almost without symptoms. Opening into the loin is heralded by the well-known local signs of abscess-formation. Evacuation into the intestines is preceded and accompanied by colicky or continuous pains and a desire to defecate; when such symptoms arise, pus should be sought for in the evacuation. Symptoms of acute peritonitis may appear; these are usually reflex, or indicate intestinal implication rather than peritonitis. Rupture into the kidney or the urethra is accompanied by mild or severe renal colics with frequent urination; the same pains, together with vesical irritability, may be present in case of rupture into the bladder, though this may take place without producing any symptoms. The downward and forward extension of the abscess is indicated by the increasing area of tenderness and the detection by palpation of inflammatory thickening of the tissues.

Rupture into the pleura is accompanied by severe cough, dyspnœa, and the physical signs of empyema; later there forms a lung abscess, or a pneumo-pyothorax; such an abscess may be evacuated through the bronchus.

In most cases immediately following rupture of the abscess there is marked amelioration of general symptoms, and the size of the tumor is decreased, but this may not be demonstrable. When fistulæ have formed they will discharge regularly and almost continuously, but not unfrequently the tracts become blocked; this is followed by prompt exaggeration of both the general symptoms and the local signs.

Diagnosis.—Perinephric abscess may be confused with—(*a*) non-inflammatory conditions of other tissues; (*b*) inflammatory conditions of other tissues; (*c*) neoplasms of the kidneys or adjacent tissues; (*d*) inflammatory conditions of the kidneys.

Of the non-inflammatory conditions, lumbago, lumbar or renal neuralgia, renal colic and fæcal impaction, are those most likely to be mistaken for perinephric abscess. In lumbago the pains are generally bilateral, do not radiate into the thighs, but along the course of the sciatic nerve, and there is more tenderness over the bony parts than over the loin. The pain in neuralgia is often intermittent, and is of a peculiar sharp quality which is not felt in perinephritis. In renal calculi there are vesical symptoms and retraction of the testicle, followed by blood and possibly stone fragments in the urine. Fæcal impaction must be differentiated by the history and by physical examination.

Certain of the infectious diseases may in their early stages simulate perinephritis: thus, influenza, small-pox, and cerebro-spinal fever may with their severe loin-pains and fever cause confusion until they have evolved their other characteristic signs. Perinephritis may also simulate typhoid fever, but here, as in the non-inflammatory conditions, there would be no leucocytosis such as accompanies perinephric abscess. It is an occasional complication of typhoid fever.

Of the inflammatory conditions of other tissues which may be confounded with perinephritis, appendicitis, parametritis, and parovaritis are the most common, with abscess of the gall-bladder, liver, or spleen as rare causes of confusion.

The pain in appendicitis generally begins as an intestinal colic, and later radiates through the abdomen or towards the umbilicus rather than into the genitalia or down the thigh. The dulness is often in front of the colon, and more marked anteriorly than posteriorly, and the peritoneal symptoms are more pronounced. Moreover, the point of greatest tenderness does not coincide in the two affections. These elements of difference, with the history, will usually determine the diagnosis. Rectal exploration should also be made, and the urine should be carefully examined for pus.

Parametritis and parovaritis can generally be differentiated by the history and by vaginal and rectal examinations.

Visceral abscesses must be excluded by the history and by physical examination.

Coxalgia and spinal tuberculosis may be closely simulated by perinephric abscess. The position of the leg may be the same as in coxalgia, but the other joint-symptoms are not present. Spinal tuberculosis causes a marked rigidity of the vertebral column, with tenderness over certain points, pain on concussion, with relief of pain on extension of the spine, and angular deformity; these symptoms are absent in perinephric abscess. Moreover, there is no leucocytosis in bone tuberculosis unassociated with mixed infection.

Neoplasms of the kidney or adjacent tissues are sometimes very difficult to exclude, since the swelling of a perinephric abscess does not always fluctuate. The age of the patient might suggest the probability of renal neoplasm; fever and flexion of the leg would almost positively point to abscess. In doubtful cases a careful examination under complete narcosis will often be necessary before deciding the question. The examination of the urine sometimes furnishes evidence of perinephritis, though, unless the secreting substance or the pelvis of the kidney is inflamed, the examination will be negative. Rapidly growing sarcomata often cause a decided leucocytosis, while a mild leucocytosis may be present in cases of cancer; thus this sign of abscess may be misleading. In doubtful cases an exploratory puncture is justifiable, since a diagnosis can usually be made from the material aspirated.

Tumors of the liver or gall-bladder on the one side, or of the spleen on the other, may be eliminated by the distention of the stomach and colon with air, whereby the percussion flatness of hepatic and splenic growths would be exaggerated, that of a perinephric abscess diminished. Ovarian cysts can usually be excluded by vaginal and rectal examination and by the history.

Of the inflammatory conditions of the kidney which may be mistaken for perinephric abscess, pyonephrosis, pyelitis, and suppurative nephritis are the most frequent. The differential diagnosis is often very difficult, but, as the treatment of all is nearly the same, the difficulties are not discouraging. The tumor of hydronephrosis or pyonephrosis resulting from a blocking of the ureter is of more sudden formation than an abscess; there is not the marked flexion of the thigh, the pain is more paroxysmal, and there is in hydronephrosis no fever. Examination of the urine is in such cases most helpful. Pyelitis and suppurative nephritis do not occasion swelling, severe pain, or flexion of the thigh. In any case where there are pyuria and the signs of perinephric abscess, it will be important to know whether the pus comes from the urinary tract or from the abscess. In such cases methyl-blue may be injected into the abscess, and, by the use of the catheter or the cystoscope, the time of the advent of the coloring-matter from the ureter may be noted. In case the abscess (or cyst or tumor) communicates with the renal pelvis or the ureter, this should occur within ten minutes.

The knowledge of leucocytosis in the various renal inflammations has not yet been so formulated as to be of clinical service. Careful repeated examinations of the urine and the history of the case are the most important elements in differentiating perinephric abscesses from the renal infections.

Prognosis.—This is dependent upon the cause of the perinephritis. When the perinephric inflammation is secondary to infection of the kidney the prognosis must be guarded. When it follows contusion of the kidney the prognosis is extremely favorable if the condition is recognized and promptly treated. Poland's statistics are instructive in relation to the value of early operation. Of eight cases treated expectantly six died. Of twenty cases treated by operation one died.

The course of primary perinephritis is usually acute, the symptoms are severe, and the inflammation quickly terminates in death or evacuation of the abscess. In a few cases the abscess has become encysted, with complete recovery, and the pathology of abscesses in other parts of the body shows the possibility of such a termination.

In case of pointing the subsequent history of the case depends upon the site of evacuation. Most favorable, of course, is lumbar or iliac evacuation, next is rupture into the colon, then rupture into the urinary tract, and most unfavorable is rupture through the diaphragm. In the secondary cases the duration and prognosis are obviously influenced by the primary conditions.

Treatment.—When the diagnosis of perinephric abscess is fairly established there can be no reason for delay in surgical intervention. Palliative treatment is indicated only during the time the surgeon is determining whether or not pus is present in the perinephric region. Before the formation of a distinct tumor it may be quite impossible to distinguish perinephritis from any of the forms of kidney infection. During this period the treatment appropriate to suppurative renal disease is indicated. This implies rest in bed, counter-irritation applied to the lumbar region, the relief of pain by injections of morphine, the administration of mild antiseptics, diuretics, and liquid diet, preferably milk, and regulation of the bowels by salines or by enemata.

When incision is practised, the opening should be in the lumbar region, and should be sufficiently large to allow of exploration of the kidney and its pelvis. It is best to use the finger instead of the knife to open up the abscess-cavity and break down septa. The admixture of urine with the pus indicates that there is an opening into the kidney pelvis, and suggests exploration of this cavity and of the ureter for the purpose of removing calculi or relieving obstruction. Frequently the pus has a fæcal odor, suggesting a communication with the bowel. This odor does not, however, indicate the formation of an intestinal fistula, but is probably due to the close proximity of the focus of suppuration to the large intestine, certain saprophytic micro-organisms contained in the colon apparently having the power to pass through its walls. When the abscess has burrowed widely its accessory cavities should be opened and drained; healing of these may be confidently expected after drainage of the centre of infection. In cases of long duration and where the abscess is of large size, the pressure may have caused marked atrophy of the kidney, or this organ may be so extensively infiltrated with pus that nephrectomy is indicated. In such cases it is safest to perform two operations, letting the patient recover from the constitutional effects of suppuration before submitting him to the shock and strain of a nephrectomy.

When the abscess has already opened, into a bronchus or the colon, for instance, it is possible that spontaneous cure may result. Surgical intervention may then be delayed, provided the patient's general condition is satisfactory and the quantity of pus discharged is diminishing. Should hectic, emaciation, and loss of strength show deficient drainage and ptomaine absorption, the centre of infection should be drained directly. The after-treatment of the incision made for drainage is important, since fistulæ are liable to persist, especially in cases of long-standing suppuration and in those complicated by pyelonephritis. Drainage should be thorough, and is best secured by gauze packing, which is so renewed at subsequent dressings that the wound heals from the bottom.

Pyelo-Paranephric Cyst.—A cystic tumor within the paranephric tissue connecting with a fistula of the renal pelvis has been described by Gallaudet. It may be due to a simultaneous rupture of the renal pelvis and the formation of a paranephric hæmatoma. The blood finally becoming absorbed leaves a connective-tissue capsule formed by perinephric tissue, the cavity of which communicates with the pelvis of the kidney. It may occur as the result of traumatism or of ulceration of the renal pelvis with urinary extravasation. Removal of the mass and closure of the fistula would constitute the treatment.

Renal Infarct.—The first indication of this in a patient with valvular cardiac disease may be sudden vomiting. There may be either retention, suppression or incontinence of urine, later followed by polyuria. Hæmaturia is rare, albuminuria develops rapidly, but is transient. The renal pain and tenderness are increased by lying on the sound side and the sensibility of the ileo-hypogastric nerve is exaggerated. (Schmidt.)

PHLEBITIS OF THE RENAL AND PERIRENAL VEINS is a rare condition, which may arise as a result of pyæmia, or may be a beginning of nephric or perinephric abscess. It presents the symptoms, both constitutional and local, of severe acute inflammation in or about the kidney with extreme tenderness, rigidity, pain, œdema of the surrounding soft parts, chills, fever and sweats of a hectic type going on to the production of pronounced cachexia. The urinary symptoms may be negative, or, if abscesses have been formed, there will be pus and blood in the urine. Suppression may occur. The extreme rigidity and tenderness which call attention to the kidney may preclude palpation of the organ. The diagnosis is made largely by exclusion and upon exploration of the kidney. The few cases seen have been unilateral.

CHAPTER XVII.

HYDRONEPHROSIS.—RENAL TUBERCULOSIS.—RENAL FISTULA.—PARASITES AND TUMORS.

HYDRONEPHROSIS.

This is a condition characterized by distention of the kidney pelvis with fluid, usually urine. Morris, however, has recorded a case in which the fluid was composed wholly of water and sodium chloride, without a trace of urea or albumen or any other characteristic of urine. It is associated with pressure, atrophy of the kidney, and interstitial nephritis, the gland and its pelvis becoming converted into a fibrous, thick-walled sac, in which the fluid is contained. The cause of hydronephrosis is obstruction to the flow of urine through any portion of the urinary tract; this results in distention and paresis of the pelvic and ureteral muscles.

Hydronephrosis may be congenital or acquired, permanent or intermittent, unilateral or bilateral, partial or total. In permanent hydronephrosis the distention is continuous; in the intermittent form of the affection there are periods during which the obstruction is relieved and the retained fluid escapes, usually into the bladder. Partial hydronephrosis is caused by blocking of one or more calices; this may be due to stone or to cicatricial contraction. Total hydronephrosis results from obstruction of the pelvic orifice or of the tract below; stone is the common cause, though blood-clots, masses of coherent pus, fragments of tissue, or parasites exceptionally may occasion obstruction. The ureters may be blocked congenitally, or as the result of external pressure, traumatism, inflammation, or lodgement of a solid or semi-solid substance. They may be strictured in any part of their course.

Congenital hydronephrosis may be unilateral or bilateral. Among the causes are imperforate urethra or ureter. Malformation, folds or duplicatures of the mucous membrane at the vesical orifice, congenital tumors of the bladder, ureters, or neighboring organs, floating kidney, and obstruction by the blood-vessels of the kidney, are occasional causes.

Congenital stricture usually entirely obliterates the ureters. There may be a narrowing at the uretero-pelvic junction, or even a valvular formation here. Later in life there is sometimes an obstruction at this point, caused by the inflamed mucous membrane, which Küster states slides downward from its attachment, thus creating a valve. The ureters sometimes enter obliquely or at an angle unfavorable to free drainage. This conformation may be congenital or may be due to gradual dilatation of the pelvis. Or the ureter may enter the pelvis at a point higher than normal, thus encouraging retention of urine and distention. Tension exerted by an unevenly distended capsule may so draw upon the ureteral orifice as to alter it in form and interfere with the flow of urine.

If the disease is bilateral it is rapidly fatal. Hydronephrosis may be present at birth or may appear subsequently because of congenital deformity. When the disease is congenital the dilatation usually attains proportionally a much greater size than when it is acquired. Even though the congenital obstruction is caused by an impervious ureter, the kidney does not atrophy, since during intra-uterine life it secretes much more slowly than after birth, and consequently intrarenal pressure is not developed with sufficient rapidity to arrest secretion before the delicate pelvic and ureteral tissues have become relaxed and overstretched.

The treatment is the same as that of acquired hydronephrosis. When there is reason to believe that the obstruction is caused by movable kidney or impacted calculus it is possible that manipulation through the abdominal walls, aided by lumbar aspiration, may relieve symptoms. When the hydronephrosis is due to stricture or to valve-formation, lumbar incision followed by an attempt to remove the obstruction is justifiable. Should the obstruction be irremediable, permanent drainage of the pelvis, or, if the disease is unilateral, nephrectomy, is indicated.

Acquired hydronephrosis is most frequent in women, probably because they are so commonly subject to pelvic disease and floating kidneys. It may be due to pelvic tumors, particularly those of a cancerous nature, displacements of the womb, pelvic inflammations, vesical neoplasms, traumatism, unnatural mobility of the kidney, calculi, stricture of the urethra, enlarged prostate, genito-urinary tuberculosis, and irritable bladder. This last condition is operative because the frequent act of micturition has a tendency constantly to close the vesico-ureteral outlets, producing backward pressure upon the pelvis of the kidney.

Of six hundred and sixty-five cases tabulated by Newman, stricture of the urethra and enlarged prostate and hypertrophy of the bladder were found to be the cause in one hundred and ninety-five bilateral and thirty-nine unilateral cases of hydronephrosis. Next in order of frequency come tumors of the pelvic organs, causing compression of the ureters. From this alone there were one hundred and forty-three bilateral and forty-one unilateral cases. Renal calculus produces unilateral hydronephrosis more often than any other of the causes noted, fifty-one cases being due to that alone; it was found to be the cause of only seventeen cases of bilateral dilatation.

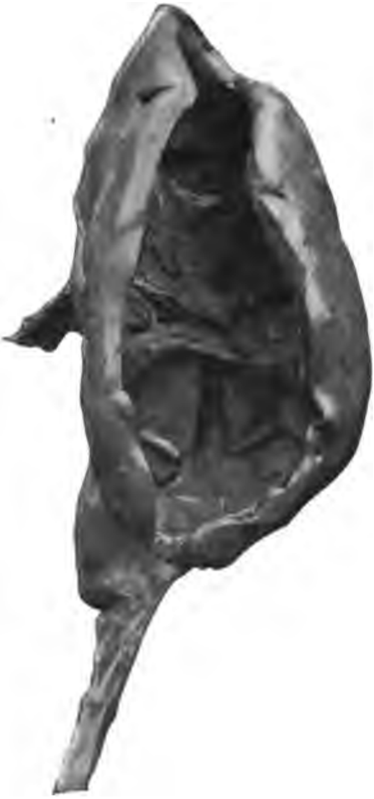
In a certain number of cases observed at post-mortem examinations no causes have been discovered. These may have been due to the acute angle of entrance of the ureter into the pelvis or to undue irritability of the ureter. It is possible that the retention of urine is under such circumstances owing to paresis of the detrusor muscles, an expression of neurosis corresponding to the vesical retention of urine observed, after traumatic, degenerative, or functional disturbances of the spinal cord.

The effect of hydronephrosis upon the kidney structure depends upon the completeness and the duration of the obstruction. Exceptionally the dilatation is confined solely to the pelvis. Usually the kidney is involved sooner or later, forming, with the pelvis, a rounded, irregularly nodulated tumor, varying greatly in size. Even in enormously dilated kidneys there may be some remnants of secreting substance. As a rule, the walls of the cyst are made up of fibrous tissue.

Griffiths has carefully studied the histological changes produced by hydronephrosis. There are two distinct processes, one the result of pressure limited to the tissue pressed upon; the other a degeneration identical with that seen in chronic interstitial nephritis, due in part to the distention of the pelvis, which by compressing and stretching the renal vessels as they pass into the kidney interferes with the nutrition of the whole organ. Distention of the pelvis takes place mainly in a forward direction, pushing the renal vessels which lie in front, and thus stretching and flattening them. In the later stages of hydronephrosis there is thickening of the intima, and even of the media, with the formation of fibrous connective tissue, thus contributing to further diminution in the calibre of the channels which supply the kidneys with blood. Occasionally thrombi develop in these vessels. The cortical substance of the kidney is the slowest to disappear.

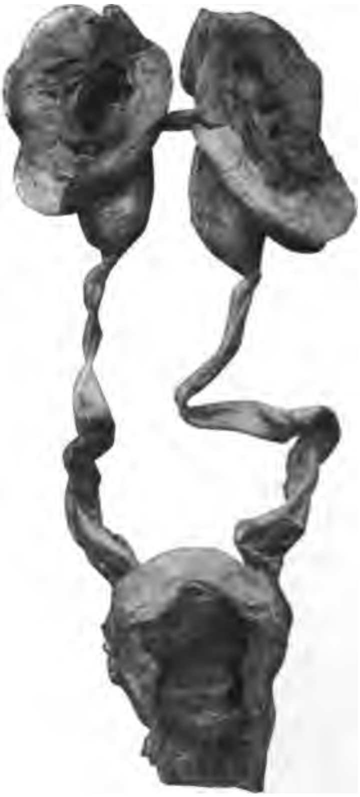
Finally the whole secreting substance is converted into connective tissue. The perinephric fat is infiltrated and adherent. The dilated larger excretory tubes persist for some time; at last even traces of these disappear, the hydronephrotic kidney forming a huge sac, sometimes incrusted with urinary salts. The participation of the ureter depends upon the seat of obstruction. This sac contains acid urine, often hyaline casts and blood. The salts are sometimes precipitated, forming a thick, semi-liquid, brownish mass. The sound kidney becomes hypertrophied. Symptoms are at times completely absent, and, provided the other kidney undergoes compensatory growth, there may be no interference with the general health. (Sehrwald.)

Fig. 186.



Destruction of kidney from hydronephrosis. (Specimen in Philadelphia Hospital Museum.)

Fig. 187.



Large vesical calculus. Contracted hypertrophied bladder, double hydronephrosis. (Specimen in Philadelphia Hospital Museum.)

Intermittent or relapsing hydronephrosis is characterized by an occasional partial or complete evacuation of the contents of the dilated kidney pelvis, followed by the passage of a large quantity of urine from the bladder. In one case, reported by Gintrac, the tumor was wont to subside suddenly by discharging into the colon, the subsidence being followed by copious watery stools.

The usual cause of intermittent hydronephrosis is movable kidney, the ureter being flexed or twisted, and remaining partially or completely impervious till a change in the position of the organ renders its duct patulous, and the retained urine freely escapes.

Occasionally intermittent hydronephrosis may be due to a calculus, which may act as a temporary ball-valve, closing the ureteral outlet from the kidney, but becoming dislodged when the pelvis is much dilated. After the subsidence of the tumor the patient may be free from symptoms for months, or even years, or the hydronephrosis may recur frequently.

Bland Sutton calls attention to the difficulty of deciding clinically between a very large hydronephrotic cyst and an ovarian or parovarian cyst, since cysts of the ovary and parovarium sometimes rupture, and the fluid escaping into the peritoneum is absorbed by this membrane and rapidly excreted by the kidneys, thus producing the characteristic symptoms of intermittent hydronephrosis,—*i.e.*, tumor which suddenly disappears and is promptly followed by diuresis.

In nearly all cases of hydronephrosis the obstruction is not complete,—that is, there is a partial escape of urine: hence, as a rule, there is likely to be intermittence in degree of tension. Clinically the term intermittent is applied only to those cases in which the swelling occasionally disappears completely.

Terrier and Boudoin collected eighty-three cases of intermittent hydronephrosis. They found floating kidney the usual cause, and called attention to the fact that the disease eventually becomes permanent, owing to inflammatory constrictions and adhesions.

Symptoms.—Unless sufficient urine is retained to produce a distinct tumor, there may be no symptoms of hydronephrosis. The obstruction is usually of such a nature that retention is gradual and painless in its onset, and dilatation of the kidney and its pelvis is not suspected until examination shows a smooth, rounded, movable, fluctuating tumor placed behind the colon and projecting into the abdominal cavity. The fluctuation can be detected only in large accumulations. Often there is a sense of weight and dragging, and sometimes there are distinct attacks of pain, resembling kidney colic, due to sudden increase of tension. Hydronephrosis develops without fever. The intermittent form of the disease is characterized by the appearance of a tumor of rapid growth, which gives rise to pain, and by sudden disappearance of the tumor, followed by polyuria. Pain which develops during the growth of the tumor may be extremely severe, and may present all the features of kidney colic. The inter-mission is sometimes as regular as are the recurrences of malarial paroxysms.

Diagnosis.—This is based on the detection of a fluctuating tumor primarily occupying the kidney region. When hydronephrosis is of such small dimensions that it cannot be felt by palpation, diagnosis is not possible except in cases of acute ureteral obstruction when kidney colic develops.

Large hydronephrotic sacs are readily confounded with ovarian cysts, especially when the evolution of the tumor and its position while still small are unknown. It can readily be seen that a sac containing thirty gallons, as in a case reported by Bland Sutton, practically fills the abdominal space. Differential diagnosis may be impossible. Aspiration may throw light on the etiology of the tumor, since the contents of a hydronephrotic sac may show traces of urea. This, however, is not always the case, and it has frequently happened that diagnosis has been made only after incision for operation. Ureteral catheterization may enable the surgeon to form a correct opinion as to the origin of a cystic tumor when every other means of differential diagnosis fails.

Prognosis.—The prognosis of hydronephrosis is favorable if the disease is unilateral. Spontaneous cure may result, probably from atrophy of the secreting substance of the kidney. The more common terminations are pyonephrosis and pyelonephritis. When the disease is bilateral the prognosis is extremely grave.

Treatment.—No internal medication has the slightest effect upon hydronephrosis. Antispasmodics may possibly be serviceable when there is reason to believe that the retention is due to spasmodic contraction of the ureter.

Surgical measures consist of—(*a*) massage and manipulation of the swelling; (*b*) ureteral instrumentation; (*c*) aspiration and tapping with a trocar and canula; (*d*) nephrotomy; (*e*) nephrectomy.

Massage and manipulation of the swelling have been successful in dislodging the obstruction when it was unquestionably caused by impacted calculus or kinks in the ureter produced by movable or floating kidney. Vigorous kneading or rough handling of the dilated pelvis is not safe, since there is a chance of rupturing the sac into the peritoneal cavity or the perinephric tissue. When the manipulation is successful the tumor subsides, and there is a free flow of urine from the bladder. The subsidence may be permanent if the obstruction is caused by impacted calculus, but will be only temporary when it is due to movable kidney. This temporary relief may be made permanent by suturing the kidney in position.

Ureteral catheterization is serviceable when retention is due to stricture of the ureter, to valve-formation, or to an anomalous entrance of the ureter into the pelvis. It may not only relieve tension but may prove curative in case of stricture. In using the ureteral catheter the danger of converting a hydronephrosis into a pyonephrosis must be fully appreciated and guarded against. Valve-formation should be subjected to operation.

Aspiration is a treatment which may be necessitated when the urgency of symptoms calls for temporary relief. There is usually a reaccumulation of fluid; in a certain number of cases after emptying the sac twice or thrice the secretion has ceased and the cure has been permanent. This is probably due to the fact that the secreting substance of the kidney has been completely atrophied. The operation is not free from risk of septic infection of the sac and the development of pyonephrosis.

The best results from puncture have followed when this was practised upon cases of traumatic hydronephrosis. Morris, of eighteen cases, reports ten cures, five deaths, and three failures. In more than half the fatal cases, he states, further treatment should have been adopted: hence the apparent mortality of this procedure is far too high. He advises, when no particular spot is suggested by discoloration or prominence, that the needle should be driven in, on the left side, an inch in front of the last intercostal space. "If there is no indication for operating elsewhere, the best spot to select when the kidney is on the right side is half-way between the last rib and the crest of the ilium, between two and two and a half inches behind the anterior superior spine of the ilium." The intestine is usually in front of the tumor and adherent to it, and may be wounded if the puncture is made too far forward.

Puncture with the trocar and canula is a much more hazardous operation, and should be discarded.

When repeated aspirations have failed to give permanent relief, nephrotomy is indicated. This operation may be performed through either the lateral abdominal or the lumbar incision. The latter is better, since it not only avoids the risks attending the opening of the peritoneal cavity, but also facilitates the performance of nephrectomy if that operation is deemed advisable after the kidney has been explored. The great objection to nephrotomy is the probability of the development of permanent urinary fistula. In a certain number of cases where the secreting substance of the kidney has entirely disappeared, after drainage the sac shrivels, and there is a good result; usually there is a constant escape of urine and the cavity becomes infected. It is, therefore, well, in case nephrotomy proves that it is impossible to restore the normal passage from the kidney pelvis to the bladder, to practise nephrectomy before infection has taken place, provided the existence of a competent healthy kidney on the opposite side is thoroughly confirmed.

Of eighteen cases of nephrotomy performed for hydronephrosis none proved fatal. Bruce Clark states that in more than fifty per cent. of cases fistula is established. Nephrotomy is performed as described in the treatment of kidney calculus.

Nephrectomy as a primary operation implies immediate removal of the entire sac. The method of operating is determined by the size of the tumor. When this is extremely large the transperitoneal method is to be preferred, since it allows freer access to the kidney. When there is but moderate dilatation the lumbar incision is the one of choice.

Arnold reports two deaths in twenty-six cases. Duplay and Reclus state that nephrotomy gives a mortality of eighteen and eight-tenths per cent., and leaves sixty-six and six-tenths per cent. of cases with fistula; nephrectomy gives thirteen and one-tenth per cent. mortality (twenty-five and eight-tenths per cent. after abdominal incision, six and four-tenths per cent. after lumbar incision). Secondary nephrectomy has always been followed by recovery. These calculations are based upon a statistical study of fifty-eight cases. Newman gives the mortality of nephrectomy as forty-one and three-tenths per cent.

TUBERCULOSIS OF THE KIDNEY.

Tuberculosis of the kidney presents itself in two general forms,—acute and chronic. By the acute form is meant the miliary infection seen in cases of general tuberculosis. Under the chronic form are classified those slow tubercular lesions of the gland which have been generally known as scrofulous pyelonephritis.

Acute renal tuberculosis is quite common, particularly in the young. In this condition there is a marked tendency to the involvement of the entire uro-genital tract, but the tubercular deposits do not attain the dimensions nor undergo the marked retrograde changes which are seen in the chronic form. The renal lesions rarely produce definite symptoms, and there is no treatment, apart from that of the general infection. The presence of tubercle bacilli in the urine is often of diagnostic value. There are no surgical indications.

Chronic renal tuberculosis may be primary or secondary, the latter being the rule.

In the primary infections the route is probably hæmatogenous, and, as in the cases of primary bone and gland tuberculosis, is unassociated with tubercular infection in any other part of the body; the mode of infection is exceedingly obscure.

In the secondary infections the primary focus may be in any part of the system; in comparison to the total number of cases of tuberculosis the kidneys are not frequently involved. The relations of renal and uro-genital tuberculosis are not yet fully understood. It seems clear that three forms are encountered: the descending form, in which the kidney-lesion is primary; the ascending form, in which some one of the subrenal tissues is first infected; and the form in which various parts of the tract are simultaneously infected. The relations in children and in adults are probably not identical. Hamill has studied the well-recorded cases in children, and concludes that the large majority of these are of the descending form, the kidney being first infected. In adults it is clear that clinically cases of the ascending form are much more frequent, though it is possible that the descending form is the more common type. Taking all cases together, males are probably more frequently affected than are females.

Renal tuberculosis occurs most commonly between the ages of twenty and forty-five, though it is by no means confined to these limits. One case has been recorded in a male infant three months old, and several cases have been seen in persons aged more than seventy years.

In the descending form of tuberculosis the condition in the beginning is usually unilateral, but later in the course of the disease the other kidney becomes infected (ascending infection from the bladder). In the ascending form the infection is usually bilateral. In hæmatogenous infection (descending) the tubercles are first formed about the glomeruli and the minute vessels, but these deposits may take place in any part of the gland. They gradually break down, and from them the infection is spread by the blood- and lymph-channels and by contiguity. The mucous membrane of the calices and pelvis soon becomes involved, either by distinct tubercular formations or by diffuse infiltration. The breaking down of the aggregated tubercles leads to the formation of cavities,—the so-called tubercular cysts. The contents are generally a yellowish-gray, blood-tinged fluid of thick consistency and urinous odor, compounded of pus, urine, blood, renal tissue, tubercular matter, and detritus, with occasional collections of lime salts, phosphates, and cholesterin. Tubercle bacilli can usually be demonstrated in the wall of the cysts, but they are not to be found in the contents.

Mixed infection is the rule in the advanced cases, and pus organisms are found in the cyst contents. The capsule of the kidney becomes sclerosed and thickened, and may present either a diffuse or a localized tubercular infiltration; it is tightly adherent to the gland. The total bulk of the organ may be considerably enlarged by massive deposits and the capacity of the pelvis much reduced; or after extensive degeneration there may be marked reduction in the size of the organ, due to contraction of the connective tissue and the capsule. In the course of time the ureter is commonly affected, and its lumen may be so narrowed that the tubercular kidney becomes hydronephrotic or pyonephrotic.

The perinephric tissue is always thickened, and may become tubercular either by extension from the true capsule, lymphatic infection, or the bursting of one of the renal cysts. Thus perinephric abscess often complicates renal tuberculosis.

In cases of ascending tuberculosis where a hydronephrosis often precedes the tubercular infection, the process commences in the mucous membrane of the pelvis, attacks the apices of the pyramids, and gradually extends towards the cortex, which it involves less profoundly than is the case in hæmatogenous infection. Obstruction, with the development of hydronephrosis and pyonephrosis, is commoner in the ascending form.

Symptoms.—There are usually no symptoms so long as the renal substance alone is affected, but pain develops when the mucous membrane of the calices becomes involved or when an abscess empties into the pelvis: hence this is often the first symptom. (Rosenstein.) The pain is at first dull and aching, and is referred to the lumbar region. At times severe paroxysms occur (renal colic), and the pain is reflected to the penis and testicles. Pain may be increased by motion and position. Some patients acquire a habit of lateral curvature, with the concavity towards the affected side, since this position lessens their suffering. Urination may occasion severe pain, referred to the vesical neck.

Urinary symptoms often occur early; later they are constant. They are of great importance. Undue frequency of urination and slight incontinence are symptoms which, in the absence of obvious cause, should always arouse suspicion of tuberculosis. (Harrison.) After infection the usual symptoms of cystitis and ureteropyelitis will develop.

Early in the disease the quantity of urine may be normal, but is often increased, constituting polyuria. As soon as the mucous membrane becomes affected, pus and blood appear in the urine. Hæmaturia is usually slight and intermittent; it may be constant, but there is much less blood than in malignant disease or calculous pyelitis. After the abscesses have once opened into the pelvis and mixed infection has taken place, pyuria is constant, except when the ureter becomes blocked; this complication is of frequent occurrence, but the obstruction is rarely permanent. In a few hours or days the blocking material becomes dislodged, and there follows a profuse gush of urine, loaded with pus and detritus. At times the tubercular matter in the urine may be so bulky that it is with difficulty voided. Albuminuria is, of course, present whenever the urine contains blood or pus, but it is usually dependent upon them. Sooner or later, however, parenchymatous inflammation occurs in either the affected kidney or its fellow, and there then develops an essential albuminuria. The urine is usually acid in the absence of pyonephrosis or bladder infection; after the advent of cystitis or when there is retention in the kidney pelvis, with mixed infection, it is alkaline. It is turbid according to the amount of pus it contains, and colored according to the amount of blood.

Microscopically, pus and blood are nearly always found, but clots are rare. Hyaline casts are commonly present, and granular casts appear when parenchymatous nephritis supervenes. Epithelial cells from the kidney and pelvis are constant in the urine of cases with advanced lesions; renal tissue is occasionally seen; connective tissue and elastic fibres are sometimes found, and are of great diagnostic value, as are the little clumps of meal-like detritus which look like conglomerated nuclei and resist all reagents.

Tubercle bacilli should be sought for in all cases, but especial care must be taken that the urine is fresh and that the smegma bacillus is excluded.

Physical examination reveals symptoms of diagnostic value. In many cases a tumor is noted in the loin, due to actual renal enlargement, to perinephric abscess, or to a hydronephrosis or pyonephrosis. This tumor may be outlined by percussion posteriorly, and may be felt through the abdominal walls. It may feel smooth or nodular, may fluctuate, and is generally tender on pressure. The enlarged ureters are sometimes palpable. Should the left kidney be the one affected, the spleen will be pushed forward and the real trouble thus obscured. Cystoscopic examination will generally show œdematous pouting of the ureteral eminence with hyperæmia or even erosions about its orifice on the side affected.

The patient suffers from progressive anæmia and digestive disturbances, with emaciation and cachexia. Irregular fever may be present, and often assumes a hectic type. Other tubercular lesions commonly develop.

Diagnosis.—The diagnosis of renal tuberculosis is founded upon—(1) a tubercular family history; (2) an otherwise inexplicable polyuria; (3) slight, transitory, apparently causeless hæmaturia; (4) frequent urination; (5) pyuria developing seemingly without sufficient cause and persisting; (6) the formation of a lumbar tumor; (7) the development of tubercular lesions in other parts of the body, particularly in the accessible portions of the genito-urinary tract; (8) the demonstration of tubercle bacilli by microscopic examination or inoculation; (9) the development of tubercular cachexia; (10) the tuberculin test.

The only single sign which is absolutely diagnostic is the finding of the tubercle bacilli. These micro-organisms cannot be differentiated from smegma bacilli by staining reaction: hence in collecting the urine care must be taken to avoid contamination from the surface of the glans or the foreskin.

Often a tubercular family history cannot be elicited. Polyuria is a very frequent and constant symptom of early renal involvement; it may, however, be excited by many other causes, and is of value from a diagnostic stand-point only when associated with other symptoms. Hæmaturia is to a certain extent characteristic; it is distinguished from the hæmaturia caused by renal tumors by the fact that the amount of blood found in the urine is trifling. Unlike hæmaturia symptomatic of renal calculus, it is not markedly influenced by active exertion. Nor does it promptly disappear after rest in bed. Frequent urination is rare, and is commonly a sign of concomitant involvement of the bladder; it sometimes precedes by many months the development of appreciable bladder-lesion, and may be a renal reflex. Pyuria may develop suddenly from rupture of a cortical abscess into the pelvis of the kidney, profuse discharge of pus suggesting this accident. It is commonly due to ascending infection, denotes the onset of pyelonephritis, and is attended by the symptoms of this condition.

The development of a lumbar tumor is of diagnostic value only when it is associated with other characteristic symptoms of renal tuberculosis. There are no peculiarities of the tubercular enlargement which would enable the surgeon to suspect the nature of the growth from physical examination. When the tubercular kidney becomes infected with pus micro-organisms—and this takes place in nearly all cases—the symptoms are simply those of a pyelitis, pyelonephritis, or suppurative nephritis, the diagnosis as to the underlying tubercular nature of the affection then resting upon the results of bacteriological examination.

From the operative stand-point it is of extreme importance to find out whether one or both kidneys is affected. This may be determined by ureteral catheterization, with the subsequent injection of the urine drawn from each kidney into susceptible animals. This is the only reliable method of deciding as to the health of an apparently uninfected kidney. Segregation is not sufficiently accurate for this purpose. In the early stages of renal tuberculosis perfectly limpid urine may be eliminated: hence a diagnosis based on the discharge of clear urine during periods when the ureter of an obviously diseased kidney is blocked is unreliable.

Prognosis.—The prognosis is unfavorable, especially when both kidneys are involved. Of thirty-two cases of renal tuberculosis, Roberts reports five as dead six months after the lesion was detected; five more died within a year, three within two years, one lived beyond this period; the remaining cases are unaccounted for. The course of the lesion is much more rapid when pyelitis and pyelonephritis develop. Le Dentu states that death is usually caused by cachexia, renal insufficiency, and gastro-intestinal catarrh.

Tuberculosis is apparently more virulent when it attacks the kidney than when it involves the bladder, prostate, or epididymis; spontaneous cure may, however, take place by a process of caseation and encapsulation.

Treatment.—In many cases, treatment can be little more than palliative. Every effort should be made to keep the patient in the best possible condition of health. This may require change of climate and surroundings and the administration of such remedies as have been proved beneficial in general tuberculosis. For the attacks of severe pain which frequently occur in the course of a tubercular pyelonephritis anodynes are indicated.

Since the process is an infectious one, the treatment which is naturally suggested is the complete removal of the tubercular focus. In its early stages the disease is usually unilateral, and may so remain throughout its entire course. Hunner reports thirty-five cases in women; in thirty-one of them but a single organ was affected. When the diagnosis is made early, and this is usually possible from urinary examination and the tuberculin test, and when there will be left one sound, normally acting kidney as determined by ureteral catheterization and segregation (see page 379), a prompt nephrectomy with removal of the ureter is indicated, since there is little reason to hope for a spontaneous arrest of the tuberculous process.

This operation is still more urgently indicated in unilateral cases of mixed infection characterized by pyonephrosis or perinephric abscess. When both kidneys are involved nephrectomy and drainage are indicated with the clear understanding on the part of the patient that permanent fistulæ will probably result.

Kümmel reports thirty-five cases of renal tuberculosis, thirty of which were subjected to nephrectomy and five to nephrotomy; twenty-eight recovered; while Krönlein states that of thirty-four nephrectomies for tuberculosis, twenty-four were living after from one to fourteen years. In no instance was death due to insufficiency of the other kidney.

In performing nephrectomy in advanced cases it may be found that the capsule of a kidney which has become degenerated as the result of tubercular pyelonephritis has contracted dense adhesions to surrounding structures, and that the loosening of these adhesions may be impossible without opening the peritoneum, tearing large vessels, or injuring neighboring organs: hence it is wise to practise subcapsular decortication, the kidney being stripped from its proper capsule by the finger until the hilum is reached, and the pedicle being formed of the tissues in this region by grasping them in a large, strong, angled hæmostatic forceps. On removal of the degenerated kidney mass, the vessels may be individually secured or the pedicle may be ligated *en masse;* it is often extremely friable, and unless this portion of the operation is carefully conducted there is danger of serious hemorrhage. The capsule is thoroughly curetted and packed with gauze when there has been mixed infection.

RENAL FISTULÆ.

Fistulæ may form spontaneously as a result of the rupture of abscesses secondary to pyonephrosis, pyelonephritis, or perinephritis, or may be caused by traumatism or surgical intervention. They may pass down to the kidney surface, to its glandular substance, or into its pelvis.

Fistulæ are named in accordance with their direction and points of opening as reno-cutaneous, reno-gastric, reno-intestinal, and reno-pulmonary.

Reno-cutaneous fistulæ usually open in the lumbar or the inguinal region; their course is fairly direct.

Reno-gastric fistulæ are extremely rare. Duplay and Reclus quote Marquezy as authority for the statement that there have been three instances in which kidney stones were expelled through the mouth.

Reno-intestinal fistulæ are comparatively frequent, particularly those opening into the colon.

The causes of fistulæ are incomplete drainage, the presence of a foreign body, as a calculus or a drainage-tube, continuous profuse suppuration, as in simple or tubercular pyelonephritis, and the constant escape of urine, as in wound of the pelvis or of the ureter. Operative fistulæ rarely develop except when infected tissues are involved in the incision.

Symptoms.—The most obvious symptom of fistula is the presence of an ulcerating opening from which escapes either urine or pus. Because of the continuous discharge there are usually marked erythema and dermatitis about the opening. When these fistulæ are of long standing, diverticula are formed, the walls become rigid, and the tract, though fairly direct, is sufficiently tortuous to prevent the easy introduction of a probe.

Reno-intestinal fistulæ are suggested by vomiting or purging of pus and urine. Reno-bronchial fistulæ are characterized by an initial profuse discharge of pus, followed by symptoms much like those of a purulent pleurisy which has broken into a bronchus.

Prognosis.—In the absence of tuberculosis the prognosis of renal fistulæ is favorable when they open on the surface; there is even a fair prospect of spontaneous cure. These fistulæ exhibit a tendency to contract slowly, thus rendering drainage insufficient. Exceptionally, especially in tubercular cases, there is a discharge so profuse that in itself it is exhausting to the patient.

Treatment.—Preventive treatment of fistulæ lies in prompt intervention in cases of renal or perirenal suppuration. When a fistula has formed and persists in spite of proper treatment, free direct drainage is indicated, followed by gauze packing and an effort to make the wound heal from the bottom. Should the fistula discharge urine, treatment is first directed towards rendering the ureter permeable and of normal calibre. When this is accomplished, the kidney may be exposed and freed from its attachments, the walls of the renal tract excised, the wound closed by catgut suture, and the parietal tract treated in the same way.

If the ureter cannot be rendered pervious, or if the fistula comes from a hopelessly disorganized pyelonephritic kidney, nephrectomy is indicated, provided the other kidney is healthy.

NEOPLASMS OF THE KIDNEY.

Tumors may be grouped in two main classes,—the primary and the secondary.

The primary neoplasms comprise the following:

A. **Epithelial Tumors.**—Of these there are several varieties.

a. ADENOMATA.—Small single or multiple adenomata are of rather frequent occurrence, particularly in the contracted kidney. Adenomata must be distinguished from adrenal inclusions and ectatic hyperplastic formations. They spring from the intratubular epithelium; the cells are cuboidal or cylindrical, and the acini have a well-formed tunica propria. Occasionally an adenoma may attain very large proportions. The so-called alveolar adenoma is really a neoplasm of adrenal structure. An especial variety is the papillary adenoma, which presents a papillary arrangement. These adenomata may become malignant (nodular type of cancer).

b. CARCINOMATA.—These develop from the intratubular epithelium; in them the urinary canals may to a certain extent persist, and if dilated may form large spaces. The much-discussed intracellular formations of cancer-cells (coccidia) are well seen in these growths.

Cancer may be single or multiple, and may attain tremendous proportions. Two types may be distinguished: the nodular type, including growths which are adeno-carcinomatous (adenomatous at the beginning) and exhibit an alveolar arrangement, with cuboidal or cylindrical cells; and the infiltrating type, including growths which are cancerous from the beginning and show little alveolar structure; their cells are polymorphous.

In the renal substance around the growth a compensatory hypertrophy may occur. More often there is a parenchymatous degeneration with interstitial overgrowth; at times amyloid degeneration. The central portions of the growth often soften and break down, forming cysts with sanguinolent contents. The pelvis of the kidney may be involved, then the walls of the ureter and perhaps of the blood-vessels, and later the adrenal and the fatty capsule; ultimately the infiltration may spread to the pancreas or the intestines.

Clinically, the neoplasm may be hard or soft, most often soft; it may become colloid and may form a fungus hæmatodes. It has been found associated with testicular carcinoma and (in the aged) with calculus. In a few cases the growth has broken through the skin. Metastasis occurs most frequently to the retroperitoneal lymph-glands, the lung, and the liver.

The disease is more common in children than in adults. Of four hundred and fifty-nine cases, one hundred and fifty-seven were noted in children less than ten years of age. Those next most commonly affected are between fifty and sixty years old, ninety-six cases being found during this decade. The following statistics taken from Senator (Nothnagel's System) illustrate the relations as to the location of the tumor and the age and sex most commonly affected.

PRIMARY CARCINOMATA OF THE KIDNEY.

Location.

Cases.	Right kidney.	Left kidney.	Both kidneys.
433	201	190	42

Sex affected.

Cases.	Males.	Females.
305	199	106

Sex affected in Children under Ten Years.

Cases.	Males.	Females.
96	58	38

Ages at which Affection occurs.

Years.	Cases.	Years.	Cases.
0 to 10	157	50 to 60	96
10 to 20	15	60 to 70	57
20 to 30	34	70 to 80	13
30 to 40	45		
40 to 50	42	Total	459

Of cases in children under ten years of age, fifty per cent. occur during the first two years and eighty-five per cent. during the first five years.

B. Tumors of Connective-Tissue Origin.

a. FIBROMATA are frequent. They are usually small, single, or multiple, hard, and spring from the intercanalicular connective tissue, either in the medulla or in the cortex.

b. LIPOMATA.—True lipomata are rare; they are not encapsulated, and lie in the cortex; they are probably developed from inclusions of the fatty capsule.

c. LEUCOMYOMATA (or lipomyomata).—These rare growths lie in the cortex, and are composed of plain muscle-cells. They are attached to the capsule, and probably develop from embryonal inclusions of the capsule whose tunica albuginea contains plain muscular tissue. They are likely to become sarcomatous.

SARCOMATA.—These are perhaps the most frequent renal tumors; small and large round-celled, spindle- and giant-celled, and melanosarcomata are seen, either pure or mixed. They spring from the intertubular or the subcapsular connective tissue.

Under the name of angiosarcomata are classed four types: (1) the ordinary angiosarcoma with many dilated vessels possessed of endothelial walls; (2) the vascular endothelioma, which springs from the endothelium of the veins; (3) the lymphatic endothelioma, springing from the lymph-tracts; and (4) the perivascular sarcoma, which springs from the cells of the tunica adventitia of the vessels, particularly the veins, presenting marked hyaline degeneration of the vessel-walls. These often bleed profusely.

Sarcomata are most common in children, are usually unilateral, may be single or multiple, and may develop to such an extent as to fill the entire abdominal cavity. Metastasis occurs, as in cancer.

TABLE OF PRIMARY RENAL SARCOMATA (from Senator).

Years.	Cases.	Years.	Cases.
0 to 1	7	20 to 40	3
1 to 2	9	40 to 60	8
2 to 6	19	60 to 80	3
6 to 10	3		—
10 to 20	6	Total	58

Females are most frequently affected; the left kidney is more often involved than the right.

C. Tumors of Heterogeneous Origin.

a. TUMORS OF SUPRARENAL ORIGIN (strumæ suprarenalis aberratæ) have often been mistaken for adenomata. They are generally small, are found in the cortex of the gland, and are composed of the elements of the suprarenal capsules (epithelium and zona pigmentosa). Similar to them is the struma accessoria, which is attached to the capsule of the kidney, and which may become large. Both of these growths contain much fat, and in the cells is found glycogen: they may undergo amyloid or hyaline degeneration. Either of these tumors may assume the type of a primary suprarenal adenoma; they have often been mistaken for true renal adenomata. They may become malignant, and are then probably to be classed as carcinomata.

B. RHABDOMYOMATA are composed of striped muscle cells; they are rich in glycogen, but are often atypical in appearance. They generally become sarcomatous, and then grow to large size. They occur in children, and are, according to the theory of Cohnheim, like the strumæ suprarenalis aberratæ. They may contain bone- and cartilage-cells.

Secondary tumors of the kidney are generally dependent upon metastasis by either the lymphatic or the vascular route. One or both kidneys may be affected; the growths are nodular, and seldom attain large size.

Symptoms of Malignant Tumors of the Kidneys.—The symptoms are those of tumor, pressure and disturbance of renal function. Pain is an early symptom, but may be absent; it is dull and dragging in character, and rarely radiates into the genitalia.

The urinary signs are very important. Hæmaturia is profuse, intermittent, and apparently causeless. Clots are often passed, and the ureter may be obstructed thereby. Complete permanent occlusion of the ureter, however, is usually caused by direct pressure of the tumor. Portions of the neoplasm may be voided. Hyaline casts are common, granular casts rare. The hemorrhages are in some cases provoked by overexertion or traumatism. Pyuria is sometimes seen. Hæmaturia in a child under seven years of age strongly suggests malignant disease.

Physical examination may furnish positive signs. The tumor is often adherent to the posterior abdominal wall, the small intestines are pushed to one side, and the colon lies upon the growth. As a rule, there is no movement upon respiration, though this is occasionally observed in cases of tumor of the right kidney. The feel of the tumor is hard, and may be smooth or nodular. Exceptionally there may be pulsation and a vascular murmur. If the colon is alternately filled with air and emptied, percussion will show that the tumor lies behind this segment of the intestine. The spleen is displaced by a tumor of the left kidney, and when the growth attains large dimensions various transpositions of the organs may be seen.

If one hand be laid upon the abdomen and the lumbar region gently tapped with the other hand, Guyon's sign may be elicited (*ballottement rênal*), a sign never produced by a normal kidney.

There are gastric and intestinal symptoms (indigestion and constipation), with occasional diarrhœa. Ascites is often present in the late stages. Pressure upon the iliac veins or the inferior vena cava may cause a more or less pronounced œdema of the legs, while severe neuralgias with paresis may result from pressure upon the ischiatic or other nerves. Varicocele upon the side of the kidney affected is common, and is made worse by standing.

In late stages the inguinal glands may become enlarged. The constitutional symptoms may remain long in abeyance. Sooner or later the patient becomes anæmic, and a marked cachexia finally develops with mental derangement and an irregular fever, due probably to uræmia or auto-intoxication. Symptoms of metastasis may appear. In some cases a high pulse-rate is maintained. Kühn has pointed out that in children with congenital sarcomata there is often a precocious development of the pubic and axillary hair and of the cutaneous pigment.

Diagnosis.—The diagnosis is founded upon profuse intermittent renal hemorrhage, the development of a kidney tumor which is steadily progressive, and the passage of fragments of neoplasm.

In the early stages of tumor the diagnosis is obscure, and the condition is liable to be confounded with renal tuberculosis and calculous pyelitis. When, however, the growth becomes palpable, the fact that it can be felt by lumbar palpation or can be so pushed forward by pressure from behind that abdominal palpation becomes much easier, is highly characteristic of renal tumor.

Cancer of the colon may closely simulate renal neoplasm; auscultatory percussion may aid in distinguishing between these two affections. Moreover, primary involvement of the colon is more commonly complicated by partial or complete intestinal obstruction and by the passage of blood-stained fæces without hæmaturia. Kidney neoplasm rarely infiltrates the colon. The lateral position of renal tumors and the lumbar bulge is in contrast to the central position of growths arising from retroperitoneal lymph-glands.

Pancreatic cysts can scarcely be distinguished from renal enlargements. Minkowsky's method of colonic distention with liquid may prove serviceable in differentiating between the two affections. When the colon is filled with water the kidney tumor is thrust back into the lumbar region.

Tumors of the suprarenal capsule do not often reach great size. Differential diagnosis between these tumors and those of the kidney is impossible.

From large pelvic tumors renal growths may be distinguished by the fact that if the patient be placed in the Trendelenburg position there may be demonstrated a tympanitic area between the pelvis and the lower border of the kidney tumor.

The intermittent, profuse, apparently causeless bleeding of renal neoplasm is simulated only by suppurative nephritis, purpura, and hæmophilia. Other symptoms of these conditions will suggest their presence; the method of distinguishing between vesical and renal bleeding has been given already. Bleeding from renal calculus is usually excited by exercise or jarring, and is promptly and favorably influenced by rest; it is not often sufficiently pronounced to cause clots: none the less, in a reported case operation was undertaken for the removal of kidney calculus when the condition present was tumor. Bleeding from tubercular kidney is slight, but may be severe. The presence of the tubercle bacillus is sometimes the only possible means of making a differential diagnosis. Differential diagnosis between epithelioma and sarcoma is not possible.

Prognosis.—Roberts has pointed out the relatively slow course of malignant infiltration when it attacks the kidney. Thus, there have been undoubted cases of renal cancer which have survived many years (ten to fifteen). Sarcomatous patients live two or three years; in epithelioma the duration of life is somewhat longer. Death usually results from metastasis and asthenia; exceptionally from hæmaturia or renal insufficiency. The ultimate prognosis is absolutely bad.

Treatment.—The treatment of malignant tumors of the kidney can be only palliative in the great majority of cases, symptoms being met as they arise. Occasionally cases are reported of successful and permanently curative removal of these growths. Success is the exception; and permanence implies a certain period of exemption, which, when it lasts two or three years, is likely to be prolonged indefinitely. When a tumor is recognizable from the exterior its extension is usually too wide to justify the expectation that nephrectomy will enable the surgeon to remove all the scattered deposits of disease. As yet but few operative cases have gone beyond the three-year limit.

The kidney may be removed by the oblique lumbar incision; one which gives plenty of room is imperative. This may involve lengthening the ordinary lumbar cut or carrying a second cut forward transversely, or resection of the last rib. If, after opening down to the kidney, examination shows that it is impossible to remove the tumor entirely, the wound should be closed and the idea of further intervention abandoned.

The wound should be closed by suture. In operations for the removal of malignant growth the renal vein may readily be torn in delivering the tumor. Injury to the vena cava is an occasional complication of nephrectomy.

In regard to the advisability of operation, Duplay and Reclus hold that if we consider the normal evolution of the disease, which sometimes lasts for six years from the appearance of the first symptoms, it seems proper to conclude that the efficiency of nephrectomy is yet to be proved. It can be regarded only as a palliative operation planned for the relief of pain and hæmaturia. It is, however, to be hoped that very early intervention may demonstrate its curative power.

CYSTS OF THE KIDNEY.

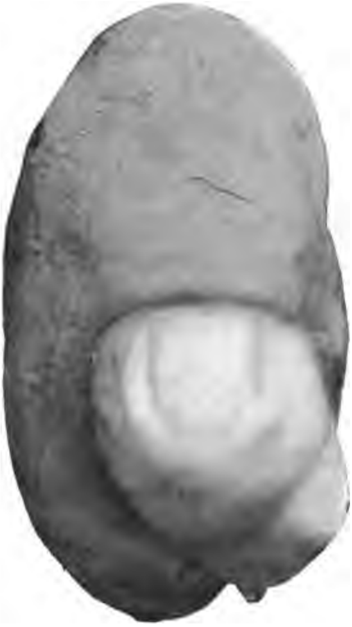
Cysts of the kidney are of three classes,—simple cysts, multilocular cysts (polycystic diseases), and hydatid cysts.

Simple cysts are either due to constriction of the urinary canals or of the neck of the capsule of Bowman, or are true adenocystomata. They may be single or double, unilateral or bilateral, small, or so large as to constitute a clinical tumor. Contracted kidneys often contain these cysts. They may involve either extremity of the kidney (usually the upper), or its mid-portion.

Agglomerated cysts are probably of two varieties,—the congenital and the acquired.

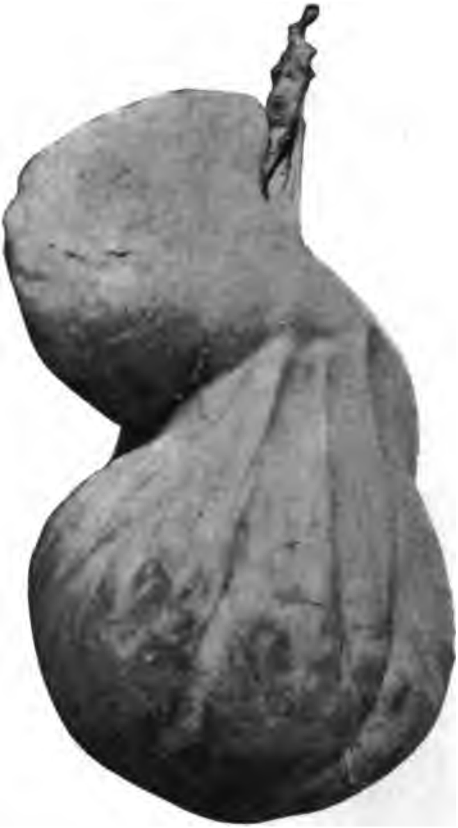
Congenital cystic disease of the kidney is due either to malformation (these cysts are often accompanied by other uro-genital deformities) or to intra-uterine renal disease (embryonal nephritis papillaris); the kidneys at birth present more or less cystic degeneration, which leads to early death through visceral compression and dyspnœa; in some cases the organs have been so large at birth as to cause dystocia. In advanced cases the entire gland is converted into a mass of cysts, although some renal tissue may be preserved. Exceptionally the disease remains latent, becoming active later in life.

FIG. 188.



Cyst of the kidney. (Specimen in Philadelphia Hospital Museum.)

FIG. 189.



Large cyst of the kidney. (Specimen in Philadelphia Hospital Museum.)

Acquired cystic disease differs little in appearance from the congenital form, except that there is more renal tissue left intact and that there are evidences that the growth was originally an adenocystoma. It occurs from the fortieth to the sixtieth year, is usually bilateral, and is often accompanied by cystic degeneration of the liver and sometimes by bronzing of the skin. In some cases it has seemed to follow an injury to the lumbar region. The contents of all these cysts are highly albuminous, and may be partly colloid. Newman has even described colloid plugs in the urinary canals. Blood may be present. The high percentage of albumen distinguishes the fluid from that of a hydronephrosis.

Symptoms.—The symptoms of renal cysts are those of nephritis, pressure, and tumor.

Signs of nephritis are present in nearly all cases (although they may be long deferred), and with them are signs of cardiac hypertrophy. Albumen may be present or absent from the urine, but slight intermittent hemorrhages occur. The patients rarely complain of sharp pain. The pressure of the growth may cause œdema and pain in the legs. Ultimately cachexia becomes marked.

The simple cysts which attain large dimensions simulate hydronephrosis.

In polycystic disease the tumor preserves the general form of the kidney; fluctuation is usually very indistinct.

Tumor, hæmaturia, and lumbar pain, if accompanied by œdema, polyuria, albuminuria, and symptoms of uræmia, are characteristic of cystic degeneration of the kidneys.

Treatment.—Simple cysts are treated by puncture, drainage, partial nephrectomy, or total nephrectomy. Puncture is commonly followed by recurrence. Drainage results in the formation of a fistula in the majority of cases, for the cure of which secondary nephrectomy is required.

Partial nephrectomy is the operation of choice when this is practicable. Bleeding from the renal tissue may be troublesome, but can usually be controlled by deep catgut sutures, or, if these fail, by packing.

Nephrectomy is often required because of the position and size of the cyst. When the tumor is large, the abdominal route should be chosen. When small, the kidney may be removed through a lumbar incision. Tuffier has collected twenty-four cases of laparonephrectomy performed for the relief of simple cyst; the mortality was forty per cent.

Cystic degeneration does not admit of surgical intervention, since the affection is usually bilateral. Many patients live for years and die of cardio-renal disease or some intercurrent affection.

PARASITES OF THE KIDNEYS.

Echinococcus.—The kidney is affected only in from five to eight per cent. of all cases of hydatid disease, and the process is generally confined to one kidney (usually the left). Any part of the gland may be affected, but the primary cyst forms in the cortex. The arrangement is that of the echinococcus hydatidosus. The cysts may become very large (eight inches in diameter), but are usually the size of an orange; they exhibit a tendency to protrude into the abdominal cavity, may contract adhesions to the abdominal walls and to the viscera, and may rupture into the pelvis, ureter, intestines, stomach, pleura, or bronchi, rarely into the peritoneum or through the lumbar muscles. Suppuration may occur spontaneously in the unruptured cyst or may be provoked by traumatism; septic absorption usually follows, and general pyæmia results. The contents of the cyst are slightly albuminous or mucoidal and contain the hooklets. Hydatid cysts may coexist in other parts of the body.

Symptoms.—There is very little acute pain in connection with hydatid renal disease; there is often a sense of discomfort and of dragging; finally, pressure-pains develop, but not until the disease is over a year old. When, however, the cyst ruptures into the pelvis a ureteral colic is provoked, with very severe paroxysms of pain; the ureter may be plugged by tissue or by a daughter cyst, with temporary or permanent hydronephrosis. In a few cases a general urticaria has followed the evacuation of the cyst.

In the event of a rupture positive diagnosis should be made by urinary analysis. After rupture the cyst becomes infected and suppurates, with the production of a pyonephrosis. In a few cases direct symptoms have been excited by pressure upon veins. Frequent urination was the chief symptom in a case of Tait's.

The tumor is round, and may be tender on pressure; it may feel hard or may fluctuate distinctly; the hydatid thrill is rarely elicited in renal cysts.

Diagnosis.—Hydatid cysts are ordinarily to be confused only with hydronephrosis or ovarian cysts. In the absence of urinary signs the cyst may be aspirated for diagnostic purposes, and tissue, the hooklets, and succinic acid sought for.

Treatment.—Recovery after spontaneous evacuation is very rare. The only treatment to be considered is operative. Four operations have been resorted to for the cure of hydatids:

1. Simple evacuation, followed by closure or the injection of iodine; this is an unsatisfactory treatment, and the cures are few.

2. Open incision. The entire cyst is evacuated, as much of the cyst-wall as possible excised, the edges of the remaining portion of the cyst sewed to the abdominal incision, and the sac packed and left to granulate.

3. Open incision, complete evacuation of contents, followed by the application of a five per cent. solution of carbolic acid and closure of the cyst without drainage. This method has given good results, but the cyst should be fastened to the parietal wall, so that subsequent drainage, if necessary, will be easily accomplished.

4. Excision of the cyst, with partial or complete nephrectomy as may be necessary. Extensive adhesions may contra-indicate this procedure.

Incision with free drainage is usually successful.

STRONGYLUS GIGAS, or "palisade worm," is a parasite of animals, the presence of which in the kidney of man is doubted.

DISTOMA HÆMATOBIUM is a parasite observed among the Fellahs and Copts. The worm lives in the portal vein and its branches. The eggs are found in the capillaries of the mucous membrane of the urinary tract. Diagnosis is based on finding the eggs or embryos.

PENTASTOMA DENTICULATUM has been found on post-mortem examination in the kidney of man.

SPIROPTERA HOMINIS and DACTYLIUS ACULEATUS have been found by Rayer in the urine. (For detailed description of these parasites, see Leuckart, "Die thierische Parasiten.")

THE SUPRARENAL CAPSULES.

A few cases of adrenal suppuration, probably tubercular; glandular proliferation; and large adenoma have been reported.

Rayer has observed in infants various neoplasms; of these, lipomata, adenomata, cysts, angiomata, fibromata, carcinomata, and sarcomata have been reported. The non-malignant growths have not been subjected to surgical intervention. Malignant tumors are mainly sarcomata, and more than one-third of the recorded cases have been observed in infancy. They become adherent to the kidney and are indistinguishable from growths of this organ. The symptoms of malignant infiltration are those of tumor of the kidney, with the exception of the alterations in the urine. These also may be found, since the kidneys are secondarily involved. Morris gives as characteristic features of adrenal neoplasm progressive weakness and emaciation, gastro-intestinal disturbances, very movable, rapidly growing tumors, and pigmentation of the skin and pronounced growth of the body hair.

Treatment.—Removal of the growth is the only treatment to be considered. Matastasis is so rapid that this affords little hope of cure. The abdominal route is to be preferred. The kidney should be saved unless there are distinct evidences of adhesion between it and the diseased suprarenal capsule.

Hypernephroma.—This though simulating both in local development and metastasis, malignant infiltration, is in reality an overgrowth of adrenal tissue, histologically resembling this and distinctly outlined from the substance of the kidney save when its growth extends into this organ. This tumor is doubtless more common than is generally supposed, since until recent times it has been confused with sarcoma. It may remain benign for a long period, or may remain locally latent, the fatal termination being caused by metastases.

The growth is at times extremely vascular and may pulsate. It is prone to give early metastases by way of the venous channels, particularly in the brain, bones, and lungs.

Symptoms.—These are those of renal tumor. In its early development hypernephroma is placed in the upper pole of the kidney. Such a tumor may last for years without giving any symptoms, but early cachexia is at times noted. It is sometimes associated with an asthenia characteristic of Addison's disease and very exceptionally with skin pigmentation. A sudden causeless hematuria, either slight or profuse, may be the first symptom which directs attention toward the kidney. A general and pronounced overgrowth of the hair has been noted, and hypertrophy of the genitalia is so common that a diagnosis has been formulated on this phenomenon associated with the presence of a renal tumor. High blood-pressure and tachycardia are suggestive symptoms.

Treatment.—This should be that applicable to malignant growths. When the tumor is in the renal substance nephrectomy is usually indicated. At times there will be found a line of cleavage between the adrenal structure and the flattened and distorted kidney, which will allow the operator to spare the latter organ.

CHAPTER XVIII.

INJURIES AND DISEASES OF THE SCROTUM AND TESTICLES.

Anatomy.—The scrotum is a pouch of skin and dartos.

The skin is provided with numerous sebaceous follicles and a few hairs, and after maturity becomes pigmented. It generally exhibits folds or rugæ passing at right angles to the raphe.

The dartos is composed of connective tissue and smooth muscular fibres. This is continuous with the superficial fascia of the groin and perineum, and forms at a position corresponding to the raphe an incomplete septum partially separating the two sides. This tissue is closely attached to the skin, and is abundantly supplied with blood-vessels. By its contraction it draws the skin of the scrotum into folds and holds the testicles up near the position of the external rings. The contraction of this muscular tissue is occasioned by sexual excitement, by cold, or by mechanical stimulus.

Beneath the dartos there is a layer of loose cellular tissue on which the muscular skin layers are freely movable, and into the meshes of which blood effusions or dropsies may readily occur.

The blood-supply to the scrotum is derived from the external pudic artery, the superficial branch of the internal pudic artery, the cremasteric artery, and the artery of the vas deferens. The lymphatics are received by the inguinal glands.

The points of practical value to be gathered from a consideration of the anatomy of the scrotum are: (1) from the close attachment of the dartos to the skin, the latter when wounded is liable to be inverted, thus making perfect apposition difficult in suturing incisions of this portion of the body; (2) in consequence of the loose texture of the cellular tissue lying within the dartos and the abundant vascularity of the scrotum, bleeding incident to traumatism is free and is likely to form large accumulations; (3) on account of this same arrangement, œdema of the scrotum is pronounced from comparatively slight causes, and when septic infection takes place there are apt to be rapid extension and sloughing.

The testicles are the two glandular organs which secrete the spermatozoa. They are held in position by the spermatic cord, and are covered by the scrotum. They are developed within the abdomen about the eighth month of fœtal life. They then descend into the scrotum, being drawn down by a musculo-fibrous cord—the gubernaculum testis—which is attached above to the base of the epididymis and below to the scrotum. Lockwood states that at the sixth to the eighth month of intra-uterine life many of the lower

Fig. 190.

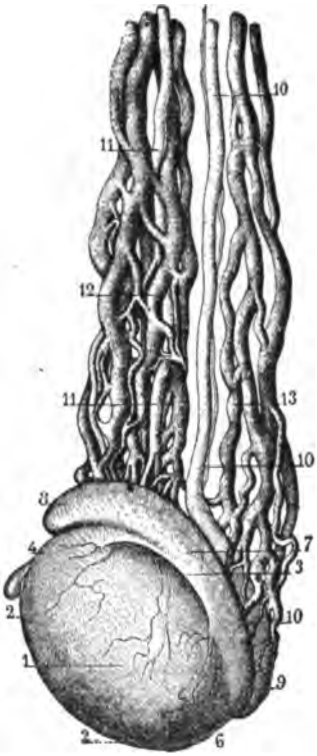


Fig. 191.

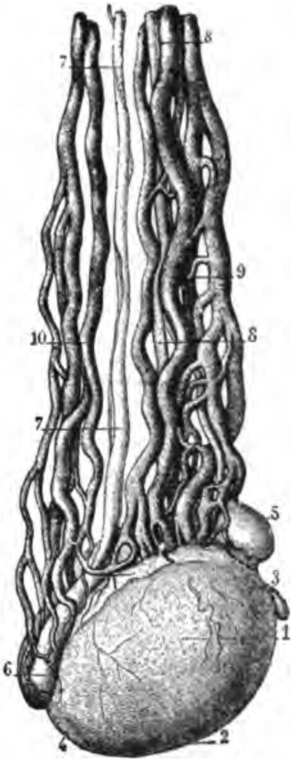


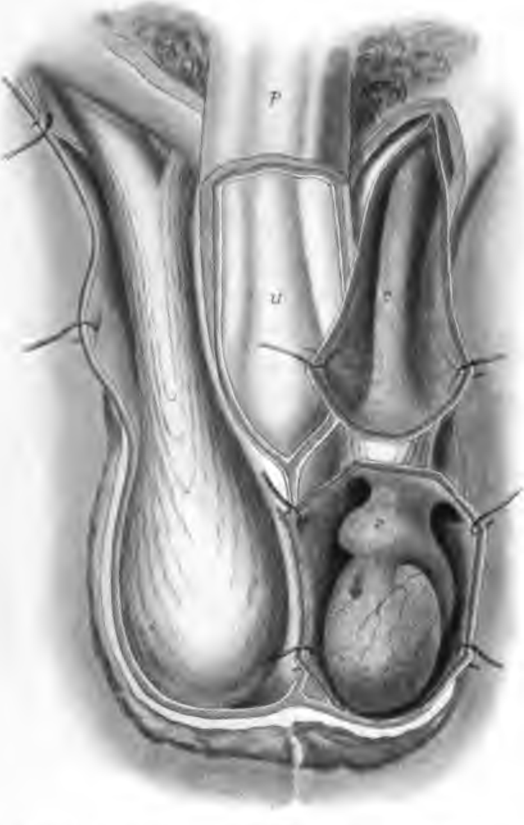
Fig. 190. Left testis. 1, outer surface ; 2, 2, antero-inferior surface ; 3, postero-superior surface : 4, anterior extremity, with hydatid of Morgagni ; 6. postero-inferior extremity ; 7, epididymis ; 8, its head ; 9, its tail ; 10, 10, 10, deferent canal ; 11, 11, spermatic artery ; 12, anterior spermatic veins surrounding the artery ; 13, posterior spermatic veins.

Fig. 191. Left testis. 1, inner surface ; 2, antero-inferior surface ; 3, anterior extremity surmounted by Morgagni's hydatid ; 4, postero-inferior surface ; 5, head of the epididymis ; 6, tail ; 7, 7, deferent canal accompanied by the deferential artery ; 8, 8, spermatic artery ; 9, anterior spermatic plexus ; 10, posterior spermatic plexus. (Sappey.)

fibres extend into Scarpa's triangle and the perineum ; this may explain the occasional presence of the testicle in these regions. They carry in their course certain coverings derived from the peritoneum.

The testis is a gland of oval form ; it is hung obliquely in the scrotum, the upper extremity being directed forward and slightly upward. (Figs. 190, 191.) It has flattened sides and is of variable

FIG. 192.



Showing the relations and coverings of the testicle and epididymis. (Testut.)

dimensions, but commonly is one and a half inches or more long, an inch broad, and an inch and a quarter from behind forward. The weight of each gland is from three-quarters of an ounce to one ounce, and the left is somewhat larger than the right.

The front and sides of the testis are convex and smooth and are covered with the visceral layer of the tunica vaginalis. The tunica vaginalis is derived from the peritoneum during the descent of the testicle in fœtal life. It is the serous covering of the testis, and is composed of two layers,—an inner visceral and an outer parietal. The inner visceral portion forms a close investment for the testicle and epididymis, while the outer parietal portion is a loose sac investing the testis and extending for some distance up the cord. The proper covering of the testicle is the tunica albuginea. This is a tough, fibrous investment, composed of bundles of white fibrous tissue, which interlace in every direction. It is covered everywhere by the tunica vaginalis, except at the points of attachment to the epididymis. At the posterior portion of the gland the tunica albuginea is inverted into the interior and forms an imperfect septum,—the mediastinum. It extends from the upper nearly to the lower border of the gland; from it numerous septa, called trabeculæ, radiate towards the surface of the testicle, dividing the interior of the latter into many incomplete spaces, conical in shape, with their bases towards the surface. The trabeculæ serve to maintain the general shape of the organ, to convey the numerous blood-vessels that ramify in its interior, and to act as supports to the glandular structure of the testicle, which is made up of lobules.

These lobules, in accordance with the arrangement of the trabeculæ, which in each testicle have been variously estimated at from one hundred and fifty to four hundred in number, are pyramidal in shape. (Fig. 193.) According to their size, the glandular lobules are made up of three or more convoluted seminiferous tubes, of which there are more than eight hundred, variously estimated as being from two to sixteen feet in length. It is in these tubes that the spermatoblasts which subsequently become converted into spermatozoa are formed. They begin in cæcal extremities or by intercommunication with other tubes, and as they approach the apices of the cones they become much less convoluted, finally uniting to form twenty or thirty ducts, which from their straight course are named the vasa recta. These vessels pass upward and backward, penetrate the mediastinum, and form an anastomotic net-work made up of channels in the fibrous tissue without proper walls and termed the rete testis. These channels terminate at the upper end of the mediastinum in twelve to twenty ducts, called the vasa efferentia, which perforate the tunica albuginea, and convey the seminal secretion to the upper part of the epididymis; they are at first straight, but subsequently become enlarged and convoluted, forming the coni vasculosi, which collectively constitute the globus major, or upper enlargement of the epididymis. (Fig. 194.) The efferent vessels finally open into a single duct, the canal of the epididymis, which constitutes by its convolutions the body and globus minor of the epididymis, measuring in its natural state about three inches in length, but when unravelled nearly twenty feet. The convolutions are held together by areolar tissue; the interior of the canal is lined by columnar ciliated epithelium.

FIG. 193.

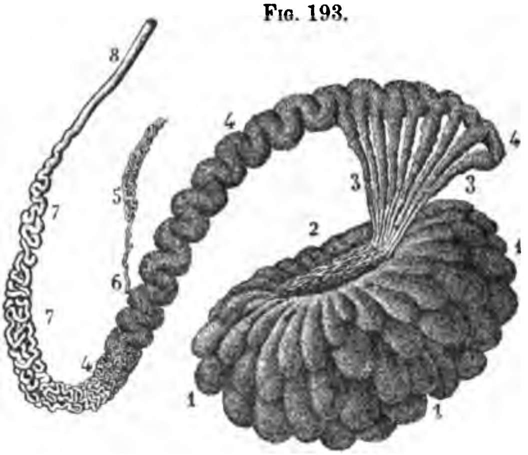


FIG. 194.

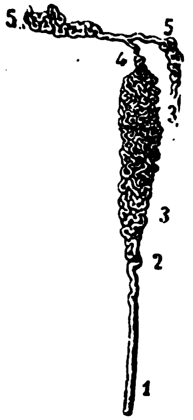


Fig. 193. The lobules of the testis, the rete vasculosum, the efferent vessels, and the epididymis. 1, 1, 1, seminiferous lobules of the testes; 2, rete vasculosum; 3, 3, efferent canals; 4, 4, 4, canal of the epididymis; 5, vas aberrans; 6, its entrance into the epididymis; 7, origin of the convoluted portion of the vas deferens; 8, vas deferens.

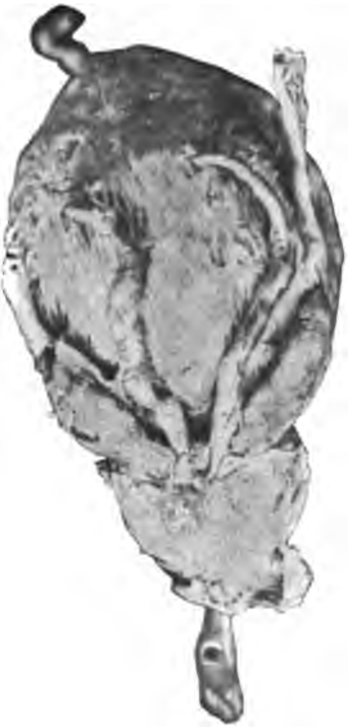
Fig. 194. 1, efferent canal. showing its comparatively large calibre and straight direction; 2, beginning convolutions; 3, cone formed by the convolutions; 4, opening of the convoluted tube into the canal of the epididymis; 5, 5, the canal of the epididymis unravelled. (Sappey.)

In fœtal life the head of the epididymis, its canal, the vas deferens, and the ejaculatory duct are formed from the canals and ducts of the Wolffian body. The vas aberrans is formed from the same body, persisting as a canal, running upward from the lower part of the epididymis or the commencement of the vas. The pedunculated body called the hydatid of Morgagni, found between the upper portion of the testis and the globus major, is a remnant of the duct of Müller.

The continuation of the convoluted canal of the epididymis is known as the vas deferens; it ascends at the back of the testicle as part of the spermatic cord, with which it is in close relation. It enters the abdomen through the internal abdominal ring and descends to the pelvis, passing forward and inward across the external iliac vessels and around the deep epigastric artery. On reaching the bladder it passes downward to the inner side of the ureter, and at its base is joined by the seminal vesicles to form the ejaculatory duct. The vas in the beginning of its course is convoluted, but for the greater part is uniformly cylindrical, and easily recognizable from the rest of the cord by its dense hard feeling; when it reaches the base of the bladder it becomes markedly ampullated. It is provided with an external cellular coat, a muscular coat, and an inner mucous membrane, the latter covered with columnar epithelium.

The seminal vesicles are glandular pouches placed between the bladder and the rectum. They are pyramidal in shape, with their bases directed backward, and, although they are of very variable size and shape in different individuals and often on the two sides, they average about two and a half inches in length and half an inch in breadth. They lie in direct contact with the base of the bladder, extending from the entrance of the ureter to the base of the prostate gland, and are separated from the rectum by the recto-vesical fascia. (Fig. 195.) Each seminal vesicle consists of an irregular tortuous tube, giving off in its course several blind pouches, which are connected by fibrous tissue. This tube becomes narrowed into a straight duct, which joins the vas deferens of the corresponding side, to form the ejaculatory duct.

FIG. 195.



Dissection showing seminal vesicles and ampullæ of the vasa in relation to the bladder and prostate.

The ejaculatory ducts are about three-quarters of an inch long. They pass forward and upward from the base of the prostate along the side of the prostatic sinus, and terminate in a slit placed at the lateral margin of this sinus. The vesicles and ducts are provided with an external fibro-cellular, a middle muscular, and an internal mucous layer; the epithelium is columnar.

The spermatic cord is about four inches in length, and extends from the internal abdominal ring to the globus minor of the epididymis. It is made up of the vas deferens, or excretory duct of the testicle, the spermatic artery from the aorta, the artery of the vas deferens from the inferior vesical, the cremasteric artery from the deep epigastric, the spermatic veins, the spermatic nerve plexus, branches of the ilio-inguinal and genito-crural nerves, and lymphatics. These structures are bound together by loose fibrous tissue, and are invested by the fasciæ carried down by the testicle in its descent. The vas deferens lies below and behind the larger anterior group of veins and the spermatic artery. The veins of the cord called the pampiniform plexus unite into a single trunk, on the right side passing into the inferior vena cava and on the left side into the left renal vein. The artery of the vas is in direct relation with it, while the spermatic artery follows a tortuous course through the cord. The nerves are distributed throughout the cord, with the exception of filaments from the hypogastric plexus, which invest the vas in a rich net-work. The four to eight lymphatic vessels empty into the glands surrounding the lower part of the aorta, and one gland lying over the external iliac artery.

DISEASES OF THE SCROTUM.

Deformities.—Congenital deformities of the scrotum unaccompanied by malformation of the penis or malposition of the testicles are practically unknown. With hypospadia and hermaphroditism the raphe becomes converted into a distinct cleft, dividing the scrotum into two halves, much like the labia majora. When there is an undescended testicle the scrotum usually does not develop on the affected side, thus producing some asymmetry. At times adhesions binding together the scrotum and the penis are noted at birth.

Injuries of the Scrotum.—Contusions may be extensive without involvement of the testicles, these organs readily slipping from the direct line of pressure. Such injuries are followed by rapid swelling, extensive subcutaneous blood effusions, and intense discoloration. They should be treated by thorough preliminary cleansing of the skin, rest, pressure, and the application of evaporating lotions. Under such treatment suppuration does not take place. When the skin is not clean, and especially when it becomes abraded, extensive and obstinate suppuration may occur.

Wounds of the scrotum are treated upon the general principles applicable to wounds of other portions of the body. Hæmostasis should be complete before closure, since the vessels are without support, and if not secured may bleed into the loose cellular tissue, forming large accumulations of blood.

At the time of suture the borders of the wound must be so approximated that the tendency to inversion of the skin will be overcome. Silk or horse-hair forms the best sewing material, Chinese silkworm-gut being too stiff for this delicate skin.

After closure and antiseptic dressing the scrotum should be supported either by means of a suspensory bandage or by a crossed of the perineum roller.

Œdema of the scrotum may be an expression of general anasarca due to lesions of the heart and kidneys, in which case it is usually pronounced, and in some instances first calls attention to the central lesion, or it may be due to inflammation of the overlying skin or of the testicles, local interference with circulation, as from lymphadenitis of the groin, infiltration of urine, rupture of a hydrocele, or septic infection. Simple œdema sometimes threatens the vitality of the part; in this case tension is relieved by multiple needle-punctures made under the strictest antiseptic precautions. Inflammatory œdema is treated by attacking the cause of inflammation,—evacuating the extravasated urine by incisions, for instance, or opening abscesses.

Emphysema may be due to entrance of air into the loose cellular tissues through a wound, such as that produced by the trocar, or to the escape of air or gas from a hollow viscus remote from the scrotum; as, for instance, when the stomach and intestines are opened, occasioning general emphysema. More commonly it is due to gas, the result of fermentation and putrefaction *in loco*, and this in a measure is an index to the extent of sloughing or gangrene going on beneath the surface.

The treatment of emphysema when it is simply aerial and is not a symptom of extensive tissue-destruction should be conservative. When it is due to the gas of decomposition, free incisions and vigorous disinfection are required.

The cutaneous affections of the scrotum are practically those of other skin surfaces of the body, and are amenable to the same treatment. It should be borne in mind, however, that the skin of the scrotum is extremely sensitive to irritating applications, such as tincture of iodine, which if painted over this region may cause intense pain for many hours.

There are certain skin eruptions which develop on the scrotum with great frequency. Among these are erythema, eczema, pruritus, and pediculosis. More rarely molluscum contagiosum, sebaceous cysts, pityriasis, and scabies are observed.

ERYTHEMA INTERTRIGO is very frequently observed in children and in fat, soft men, especially those who are rheumatic in tendency or are uncleanly in their habits and who are given to exercise, such as walking, which occasions friction between moist surfaces.

The treatment consists in thorough cleanliness and the interposition of a layer of soft muslin or lint between the chafing surfaces, or, better still, the application of a suspensory bandage, made of thin gauze. The parts are bathed in weak solutions of carbolic acid 1 to 200 and hydrastis canadensis 1 to 20, after which they are carefully dried and dusted with finely powdered zinc stearate powder. In some cases ointments give better results. One of the best is that of resorcin two per cent. made up with lanolin and lard equal parts.

ECZEMA may develop in healthy persons, though it is more frequently observed in association with the gouty or rheumatic diathesis, sometimes in connection with diabetes. It may appear in almost any of its various forms, is extremely obstinate, and causes intense itching and burning. There are frequently concomitant swelling of the whole scrotum, deepening of the transverse rugæ, and the formation of raw surfaces from which there exudes an offensive discharge.

The treatment is that generally applicable to this disease.

Among the most useful prescriptions are the following:

℞ Zinci oxidi,
Zinci carbonat., āā ʒvi;
Glycerini, fʒiv;
Liquor. calcis, f℥vi.
M. S.—Shake well before applying.

This should be dabbed on for four or five minutes. In chronic cases with thickening the following may be applied (Bulkley):

℞ Picis liquidæ, ʒii;
Potassæ causticæ, ʒi;
Aquæ, fʒv.

This may be used as an antipruritic, diluted with twenty to thirty parts of water, or may be rubbed directly into the infiltration.

An excellent powder to be employed during the day is the following:

℞ Pulv. amyli, ʒvi;
Zinci oxidi, ʒiss;
Pulv. camphoræ, ʒss;

or

℞ Thymol, gr. ii;
Pulv. zinci stearat., ʒiv.

PRURITUS is most frequently observed in rheumatic or gouty subjects. Though often associated with the lesions of pediculi, it may develop independently of these.

The treatment must be in the main systemic, though the local antipruritic applications, such as thymol, tannic acid, etc., are serviceable. Prolonged hot bathing of the parts is useful.

PEDICULOSIS ultimately excites intense pruritus, though it is often not detected for a long time. Careful examination of the scrotum shows the parasites at once. They appear as minute scabs, most abundant about the root of the penis. The ova are found on the hairs.

The application of an ointment of twenty per cent. oleate of mercury one part, cosmoline two parts, or of mercurial ointment one part, cosmoline three parts, rubbed into the scrotum every night, the excess being wiped off with a soft towel before retiring, and the whole region being washed with soap and hot water the following morning, will be followed by cure in a few days.

Tincture of cocculus indicus applied freely after a warm bath and allowed to dry on the part is more cleanly and efficacious.

MOLLUSCUM CONTAGIOSUM, observed mostly in children, particularly affects the scrotum. The lesions consist of small, waxy, almost spherical tumors or cysts, situated in the superficial layers of the skin. They are sessile, but may become pedunculated when they have existed for a considerable time without softening. At first smooth and round, they become umbilicated, exhibiting a small black spot in the centre of the depression, which indicates the opening into the follicle. They grow slowly, and occasion no pain unless complicated by inflammation.

They may disappear spontaneously, but should be removed, since they are contagious. The contents of the cyst may be squeezed out and the walls touched with pure carbolic acid. Pedunculated growths should be snipped off and their bases cauterized.

STEATOMATA OR SEBACEOUS CYSTS have not the waxy appearance of molluscum, nor do they appear in childhood. They are usually single, but may be multiple. They are soft and doughy in consistence, and when attacked by inflammation break down and suppurate. They sometimes attain the size of a hen's egg. The thin overlying skin becomes adherent in inflammatory cases. Incision followed by removal of the entire sac is the only effective treatment.

Gangrene of the Scrotum.—This affection, extremely rare, except as a complication of rupture of the urethra or as a sequel of extensive traumatism, has been attributed, when it follows inflammation of the inguinal glands or operation on these structures, to reflected nerve irritation. It is more probable that gangrene developing apparently spontaneously, or, as in the case contributed by Bungner, following inguinal adenitis in the course of grippe, is due to infection with the ordinary pus microbes.

Among the causes of this condition are included urinary infiltration, erysipelas, thrombosis, embolism, and incidentally influenza, typhus and other fevers, syphilis, gonorrhœa, diabetes, prostatic disease, pediculi pubis, ergotism, traumatism (faulty punctures and injections), and frost-bite.

Even though the testicles be completely denuded, they will ultimately be covered by granulation-tissue and their function will be preserved.

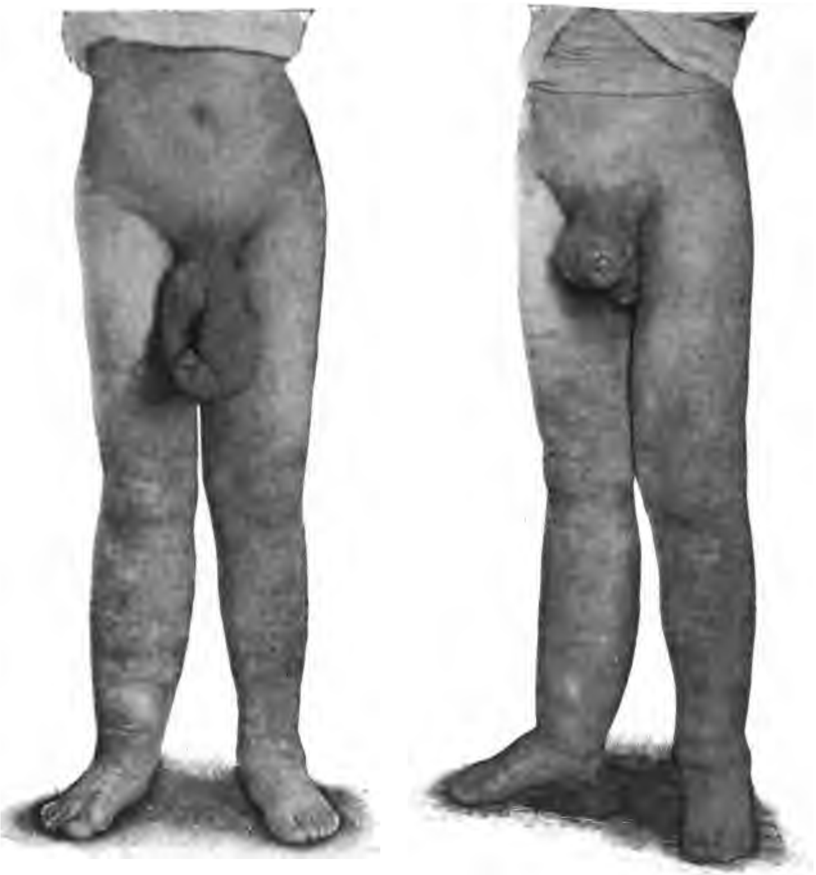
Treatment.—Scrotal gangrene should be treated by hot antiseptic fomentations until the sloughs separate. The testicle should then be covered as completely as possible by suturing the remaining healthy skin, the wound being dressed daily until complete healing, with gauze wrung out of 1 to 10,000 bichloride solution or other antiseptic lotion. When due to urinary infiltration—the usual cause—free incisions, and direct drainage from the point of urethral rupture are indicated.

Elephantiasis, endemic in certain countries, is rare in the United States. It is generally supposed to be due to the stoppage of lymph-channels by the ova of the filaria sanguinis hominis, but in this country it has been observed in cases in which the parasite was not present in the blood, and the obstruction to the flow of lymph could be accounted for only by some preceding inflammatory condition, such as recurrent attacks of erysipelas or dermatitis, or cicatrization following syphilitic lesions or excision of the inguinal glands.

Prunner states that the disease always begins in the form of a hard kernel under the skin, usually at the bottom of the left side of the scrotum. This spreads in all directions, forming a diffuse, hard, thick, wrinkled skin tumefaction. The tumor is pyriform, and the rough, often warty, skin covering it is likely to become excoriated from the irritation of the urine. The growth may attain an enormous size, weighing as much as two hundred pounds. It is commonly associated with some degree of elephantiasis of the skin of the lower extremities. The testicles and penis, however, remain unaffected. (Fig. 196.)

Treatment.—In the early stages galvanism and the internal administration of potassium iodide may be serviceable. When the tumor attains such size as to be inconvenient from its weight, complete excision of all the diseased tissues is indicated. This operation is usually bloody, many vessels requiring ligation. The best means of checking hemorrhage during removal is to transfix the tumor at its base with long pins, and to apply behind these transfixing pins, the elastic ligature. The fact that hernia frequently complicates this affection must be borne in mind in applying these transfixing pins and securing the elastic band. The penis and testicles are first freed, then all the diseased tissue is cut away. Even though the testicles are entirely denuded, this need not occasion anxiety, since they will be covered by granulation-tissue.

FIG. 196.



Elephantiasis of the penis and scrotum, showing the result of operation.

Tumors of the Scrotum.—EPITHELIOMA.—Aside from sebaceous cysts, epithelioma is the most frequent form of new growth observed upon the scrotum. It is called "chimney-sweepers' cancer," because it formerly attacked by preference people engaged in this work. In recent years the method of cleaning chimneys has changed, and the name is no longer applicable.

It begins as an indurated wart, which becomes excoriated and scabby on its surface; this wart is shortly transformed into an ulcer, which is characterized by hard, raised edges, uneven surface, unhealthy granulations, and the exudation of ichorous pus. It is sometimes extremely painful, and steadily extends, ultimately involving the inguinal lymphatic glands, which soften and ulcerate. It is stated that workers in coal-tar are especially liable to this form of disease.

Treatment.—The treatment consists in the removal of the indurated tissues by an incision carried wide of the diseased area. Any enlarged lymph-glands should be removed at the same time. Thus treated early in the course of the affection the prognosis is favorable.

Fatty tumors are at times observed; they are of importance because of their intimate connection with the testicle. Diagnosis is rarely possible without exploratory incision, because, on palpation, they feel almost precisely as does an irreducible omental hernia. Excision is the only treatment.

Fibromata are rarely observed. They are freely movable under the skin. They should be removed as soon as discovered, since in their development they may form adhesions to the testicle, which would make subsequent operation without injury to this gland extremely difficult. These fibrous tumors sometimes recur in spite of their removal.

Gummata, enchondromata, osteomata, and cysts are occasionally observed.

ANOMALIES OF THE TESTICLE.

Anomalies of development.	In number.	Excess.	Polyorchism.
		Deficiency.	Absence, anorchism. Fusion, synorchism.
	In size.	Excess.	Hypertrophy.
		Deficiency.	Arrested development.
Anomalies of migration.		Testicle undescended.	Lying in some part of the normal course. Lying outside of the normal course.
		Testicle descended.	Inversion.

(Monod and Terrillon.)

Anomalies of Number.—1. Polyorchism.—With the exception of the case reported by Blasius, there seems to be no well-authenticated record of supernumerary testis. Cases are frequently encountered in which careful examination shows the existence of a body which in size, shape, and position corresponds closely to a third testicle; even the testicular sensation—*i.e.*, sickening pain on pressure—may be present. When such cases have been subject to operation, or when an opportunity has been given for post-mortem examination, these apparently supernumerary testes have been proved to be encysted hydroceles, epiploceles, fibromata, or other comparatively common pathological conditions.

2. Anorchism.—This deformity may be unilateral (monorchism) or bilateral. It is usually unilateral, and the epididymis and scrotal portion of the vas are also absent. The pelvic portion of the vas and the seminal vesicles are ordinarily present, though cases are recorded showing that even these portions of the genital tract may be wanting. The testicle may be present, but the epididymis or vas or both these structures may be absent. Bilateral anorchism is accompanied by

The testicle may be present, but the epididymis or vas or both these structures may be absent. Bilateral anorchism is accompanied by

absence or incomplete development of the scrotum, a rudimentary condition of the external genitalia, impotence, sterility, and the physical and mental attributes of eunuchism.

Diagnosis.—It is not justifiable to infer that a testicle is absent because it is not found in the scrotum or the inguinal canal. Indeed, a positive diagnosis of unilateral anorchism must be based upon the results of post-mortem examination, since the testis may be retained in the abdominal cavity. A distinction between bilateral retention and anorchism can be made by the rudimentary condition of the penis when the testicles are absent, and by the later development of eunuchism.

Treatment.—Unilateral anorchism gives rise to no symptoms, since one testis, if it remains healthy, is competent to perform the functions of both. Bilateral anorchism would seem to be beyond help. Modern research in other lines of work, however, suggests the possibility of so modifying the course of development that, though potency and fertility cannot be expected, the physical and mental characteristics of the male may be preserved. While the removal of either testicles or ovaries in early life usually changes profoundly all the characteristics, physical and mental, of the individual, there is abundant evidence that the testicles may lose or may never have had the sperm-producing power and still possess the quality which enables them to hold the organism in its normal groove and to invest it with the other attributes of masculinity. When testes fail to descend, as a rule, they are incapable of producing spermatozoa. In spite of this imperfection of the organs, the external bodily characteristics of the male are acquired. It is obvious that the testicle, in addition to producing spermatozoa, elaborates an internal secretion which profoundly affects general nutrition. (Griffiths.)

It is possible that the function of .the testicles which relates to the preservation of masculinity, as distinguished from the function of reproduction, may be exerted through a definite substance which has distinct physiological properties of its own, manifest to some extent whenever it is introduced into the system.

It therefore seems reasonable to hope that testicular injections may exert a powerful influence on the general development of bilateral anorchids. These injections should be instituted at an early age, certainly before puberty, and should be continued for many years. A trial of this method has never been made: hence the dosage, the number of repetitions, and the period of time over which treatment should extend cannot be formulated. It has merely the merit of being the only treatment thus far proposed.

Anomalies in Size.—HYPERTROPHY.—In common with all the genital organs, the normal testicles vary greatly in size and without any definite relation to the general physical development. It is, therefore, difficult to determine what degree of growth indicates a departure from the normal. In cases where one testicle has been removed or has become atrophied, the remaining gland may show so marked an overgrowth as to be properly considered hypertrophied. This is particularly likely to occur when there is congenital atrophy or unilateral ectopy. The destruction of the testicle by inflammation, unless this occurs in early life, is not commonly followed by enlargement of the other gland.

ATROPHY.—The wasting which follows acute or chronic inflammation cannot properly be considered a congenital malformation, even though this atrophic process takes place in early infancy. True atrophy is nearly always observed in cases of non-descent and ectopy. Even when the position of the organ is perfect one or both testes may remain puerile. It is a matter of clinical observation that these puerile testes may attain full development as a result of physiological activity.

SYNORCHISM, or fusion of the testicles, is an extremely rare condition. It seems to have been found only in fœtal life. The diagnosis of the condition is dependent upon the finding of two cords.

Treatment.—Hypertrophy calls for no treatment, since it is compensatory and is dependent upon increased physiological activity. It is probable that a gland thus enlarged is more vulnerable than one of normal size: hence it is desirable to support it by a suspensory bandage if the scrotum is relaxed, and to caution the patient as to the special danger incident to urethritis.

The treatment of imperfect development of the testes promises little. There is, however, sufficient clinical evidence to prove that persistent, long-continued treatment may be followed by gratifying results. The stimulating influence of massage regularly administered should be borne in mind, and the effect which physiological activity has upon growth and nutrition should be considered in advising such patients and in predicting as to their future.

The transplantation of an undescended testicle has been followed by rapid increase in size.

Anomalies in Migration.—The testicle may be arrested in its transit from below the kidney to the bottom of the scrotum at any portion of its course. It may depart from its regular path, taking an aberrant course, or, having descended normally, it may assume a faulty position in the scrotum.

Arrest of Passage in the Normal Course.—The testicle may be arrested in the abdominal cavity or in the inguinal canal, or may not fully descend into the scrotum.

Abdominal retention, or cryptorchism, may be unilateral or bilateral. The testicle may be found close to the posterior abdominal wall in relation to the lower border of the kidney, it may be provided with a long mesorchium allowing it to move freely in the abdominal cavity, or it may lie in the iliac fossa close to the internal ring.

Griffiths, in an experimental investigation on dogs, found that although the abdominal testicle develops to the time of puberty, it never produces spermatozoa. When the testes of grown dogs were placed in the abdominal cavity they atrophied and no longer produced spermatozoa.

In inguinal retention the testicle may be arrested at the internal ring, in the inguinal canal, or at the external ring, and until it becomes adherent by inflammation it is usually extremely mobile.

This variety is most important because of its frequency, because from its exposed position the testicle is subject to irritation and injury, and, finally, because it is liable to be mistaken for hernia.

In incomplete scrotal descent (cruro-scrotal retention) the testicle lies outside of the inguinal canal, but fails to descend completely, and is found in the fold between the scrotum and the thigh, at varying distances from the ring.

When the testicle takes an aberrant course (ectopy) it may be found beneath the skin of the abdominal wall at a variable distance from the external abdominal ring, in the crural region, or in the perineum.

In perineal ectopy the testicle is found as a distinct ovoid tumor, lying to one side of the central raphe and in front of the anus. The cord can often be traced from this tumor to the external abdominal ring, and the overlying skin sometimes presents the peculiarities of the scrotum, the corresponding side of this sac being generally atrophied. It is easily seen that a testis thus placed can scarcely escape frequent injury, and inflammation and destruction of secreting structure.

In femoral ectopy the testicle occupies the position of a complete femoral hernia, though Curling notes a case in which the gland was three inches below Poupart's ligament and behind the femoral vein, with the cord encircling this vessel. The testicle passes beneath Poupart's ligament and through the saphenous opening.

Curling, after considering the etiology of non-descent, maintains that in some cases retention is due to the small size of the external ring. Other causes which may be operative are the application of a tight-fitting truss before the descent of the testes, shortness of the vessels of the cord, and a long mesorchium preventing the testicle from entering the canal.

The irregular development of the gubernaculum will explain crurofemoral and peno-pubic ectopy. The lower attachments of this fibromuscular structure are Poupart's ligament in the course of the inguinal canal (Curling), the lower part of the scrotum, and the pubic bone. There are also fibres passing to the region of the saphenous opening. Relative over-development of certain of these bands may draw the testicle into a faulty position.

As a rule, misplaced testicles are undersized, though apparently healthy until they have been subjected to repeated attacks of inflammation. When removed from the adult and examined they show degeneration and atrophy of the secreting structure. This, however, is inflammatory in nature and not inseparably connected with underdevelopment. Curling holds that undescended testicles are functionless so far as reproduction is concerned, and hence that bilateral retention causes sterility, though not necessarily impotence.

Monod and Arthaud have attempted to demonstrate, on the other hand, that a retained testicle may secrete healthy semen and show no degenerative changes on section, such alterations being due to repeated inflammations to which the gland is necessarily subject from its faulty position. In one undescended testicle which we removed from a man forty-five years old in the course of a radical operation for strangulated hernia, microscopic section of the gland, which was about the size of that normally found in a child of twelve, showed it to be fully functional, although it had been subject to a number of inflammatory attacks.

Incomplete transit is most commonly manifested in the form of inguinal retention; the aberrant transit, in the form of perineal ectopy.

Complications of Misplaced Testicles.—Hernia, inflammation, and malignant degeneration are the serious complications of abnormally placed testes.

Hernia is an extremely common complication, and is usually of the congenital variety,—*i.e.*, there is a direct communication from the abdominal cavity to the testis, the funicular portion of the peritoneal sac not having become obliterated. The funicular form is also found; in this the testicle is shut off, but the peritoneal pouch which descends with the cord still remains patulous. Hernia is a grave complication of misplaced testis, since it is especially liable to sudden and complete strangulation. Because of the presence of the testicle a retaining truss can rarely be worn.

Inflammation frequently attacks a misplaced testicle, particularly the inguinal form, since the imperfectly developed gland seems to be especially vulnerable. Inflammation may be due to traumatism or to extension of infection from the posterior urethra. Traumatic inflammation may be caused by a blow or by sudden contraction of the abdominal muscles, which pinch the testicle in its already too straitened environment. It is probable that the misplaced testicle is not immune against the infection which develops in the course of mumps, typhoid fever, and other diseases which are often complicated by orchitis. Jacobson states that syphilis and tuberculosis have not been observed to attack such testes.

Malignant Degeneration.—The comparative frequency with which malignant disease attacks misplaced testicles is generally recognized. The predisposition is probably due to the frequent inflammatory attacks to which the gland is subjected. The growths found are usually sarcoma and encephaloid carcinoma.

Symptoms.—Symptoms of anomalies of migration of the testis are wanting. Until the onset of complications there will be no complaint, except perhaps slight transitory testicular pain, caused by sudden violent muscular exertion or by blows or jars in the region of the misplaced gland. The complications are, however, extremely important, since some of them directly threaten life.

The symptoms of orchitis are practically the same whether the testis is descended or undescended. There are sickening, even agonizing pain, radiating into the scrotum and down the thighs, exquisite tenderness, and often abdominal reflexes so pronounced as strongly to suggest acute peritonitis. The constitutional symptoms are proportionate in severity to the degree of inflammation, and are most pronounced when the testicle becomes gangrenous, either from the violence of traumatism or inflammation, or from torsion; this accident seems to be especially common in cases of inguinal retention.

Hydrocele and hæmatocele frequently complicate inflammation. Hydrocele may be of the congenital variety,—that is, reducible into the peritoneal cavity; sooner or later it becomes distinctly limited.

Exceptionally, the testicular inflammation may cause general peritonitis; Curling has reported one death from this complication. Very commonly abdominal symptoms develop so suddenly and violently that they closely simulate those dependent upon the presence of a strangulated hernia. There may be tympany, tenderness, constipation, and vomiting so persistent as to have a markedly stercoraceous character. The distinction between orchi-epididymitis attacking an undescended testicle and strangulated inguinal hernia is often extremely difficult to make.

Hernia when it complicates undescended testicle is manifested by the usual symptoms, but will often exhibit the peculiarity of not being amenable to treatment by truss, pressure of the pad producing so much pain that it cannot be borne. The hernia may pass beyond the testis, reaching the scrotum ; sometimes it pushes the testis in front of it, thus curing the displacement. When the hernia becomes strangulated the symptoms are not different from those commonly observed in strangulated hernia.

Malignant degeneration exhibits the symptoms which characterize cancer of the normally placed testis, except the location of the tumor. The testicle steadily and rapidly enlarges, becomes irregular in shape, often cystic, painful, and involves the anatomically related glands. The skin is discolored and marked by large veins. In cases of abdominal retention the diagnosis cannot, of course, be formulated until the tumor has reached considerable size, since till then it is not palpable. A persistent, steadily increasing, obstinate pain should in the case of abdominal retention suggest the possibility of malignant infiltration. In the late course of malignant disease the diagnosis cannot for a moment be in doubt, since the large palpable tumor and glandular involvement are characteristic.

Diagnosis.—The diagnosis of misplaced testicle is based on (1) the absence of the gland from its normal position; in infants and young children the testes may be extremely small, sometimes not much larger than a kidney-bean, and because of their great mobility may be hard to find ; (2) the detection in the abnormal position of a smooth, usually movable tumor, shaped like a normal testicle, but smaller, and yielding on pressure the testicular sensation ; in making this examination, unless the testis is found, the patient should be instructed to cough and strain, since thus there may be brought within reach an undescended testis lying high up in the inguinal canal ; (3) atrophy of the scrotum of the side corresponding to the misplacement. In cases of abdominal retention the only signs are absence of the testis from the normal position and atrophy of the scrotum.

Prognosis.—The prognosis of imperfect descent of testicles is fairly good in young children, since ultimately the gland is likely to reach its proper position. This is not true of ectopy. In case the gland does not descend before birth, it commonly does so shortly afterwards, and no anxiety should be experienced for several weeks, especially if the testicles can be felt in the inguinal region and the scrotum is properly developed. If the descent does not take place during infancy or childhood, there is still a chance that it may occur about the period of puberty, sometimes as the result of violent straining effort. The gradual descent is often complicated by hernia.

As a rule, a testicle which has shown no signs of descent by the sixth year will retain its faulty position unless subjected to surgical treatment.

Treatment.—It is generally conceded that intra-abdominal ectopy cannot be benefited by surgical intervention. The vascular and nervous attachments of the gland are too short to allow of its being drawn into its proper position. A partially successful effort, bringing it into the inguinal canal, would be worse than useless. Guelliot, however, reports a most suggestive case. He operated for bilateral abdominal ectopy: one testis was secured in the scrotum; two years later this gland was well developed, and the boy, then eighteen years old, was normal in regard to his sexual functions. In the semen were found a few apparently normal spermatozoa. While it is probable that patients subject to bilateral abdominal retention of the testicle will be sterile, they are likely to suffer from no inconvenience, since the gland is so placed as to be protected from injury.

Inguinal retention should be treated conservatively when it is observed in early life. The gland should be encouraged to descend to its normal position by gentle manipulation with the fingers, and should be kept without the external abdominal ring by the application of a pressure bandage or a truss, in case this can be so applied as not to cause pain.

Persistence in this treatment is justifiable to the sixth or eighth year if the testicle in the mean time does not become inflamed or show signs of atrophy. After the sixth year the operative treatment may be considered, but it should be remembered that spontaneous descent may take place about the period of puberty; this is, however, not the rule. Operation is especially indicated if the malformation is bilateral, if the testicle has been subject to repeated attacks of inflammation, or if from its position and its chronically inflamed condition it prevents proper indulgence in active sports.

Since one of the reasons for operating is to encourage growth, this should be undertaken before the most active period of development. The ordinary position of the misplaced testicle is just within the external ring; an incision sufficiently large to expose it is made directly over the gland. The incision divides the skin, the superficial fascia, and the aponeurosis of the external oblique, which is often very thin. The testicle is then carefully examined, to see that it is not complicated by hernia. Should this be present and should the vaginal tunic communicate with the peritoneal cavity, the hernial sac is cut across just above the testis, and the distal end is closed with catgut sutures, thus forming a closed tunica vaginalis. The proximal end is then dissected up to the internal ring and there ligated. After the testicle is thoroughly exposed, the cord is stretched until the gland hangs freely beyond the external abdominal ring. This should always be preceded by transverse division of all the fibres of the cremaster muscle and the fibrous envelope of the cord, leaving only the vas with its vessels and nerves. Incomplete division of the musculo-fibrous funicular sheath is the common cause of failure in this operation.

The testicle having been drawn well out so that it exhibits no tendency to retract within the inguinal canal, the finger is thrust from the lower corner of the wound into the scrotum, tearing a way through the loose areolar tissue. The scrotum is then invaginated until its inner surface appears in the wound, and the testis is fastened to it by one or two silk or chromicized catgut sutures, which include the proper tunic of the lower extremity of the gland and epididymis and the deeper layers of the scrotal skin. The aponeurosis of the external oblique is then closed with chromicized catgut, the external ring being made as small as is possible without interfering with the circulation of the cord. The cord is sutured to the borders of the ring and the wound is closed, a moderately firm compress being so placed that the testicle is kept in its normal position. The operation is simple and is unattended with danger. It has frequently failed because of the tendency to retraction. This is best avoided by making the external ring small and by thorough division of the fibro-muscular structures of the cord.

Jalaguier reports fifteen operations of orchidopexy; fourteen were successful. In two cases at the end of thirty to thirty-six months the testicles had become normal in size, and in twelve others at the end of from three to fifteen months the organs were movable, sensitive, of normal consistence, and showed no tendency to retract. He advocates the operation in children over five years, and in younger children when the undescended testis is complicated by painful hernia. Terrillon in six cases had three satisfactory results.

When the scrotal sac is shallow an almost transverse incision is made directly over the position the testicle should occupy. After completion of the operation the wound is sutured at right angles to its original course, thus providing a pouch for the testis. In very young children—*i.e.*, those who cannot be prevented from wetting the dressings—the wound should be thoroughly protected by a cotton collodion dressing.

Cruro-scrotal retention is usually amenable to manipulation and the application of a truss provided with a water-pad which presses from above downward. Should the testis remain tightly apposed to the external ring, occasioning pain on muscular effort, the displacement should be cured by the operation indicated for the relief of an inguinal retention.

Perineal ectopy should always be subjected to operation, since from its position the testicle is exposed to frequent injury. The advice is usually given to wait until the third or fourth year of life before attempting replacement, mainly because after that time there is less danger of infection through soiling the dressings. We believe it is well to follow this plan, provided the testis is not injured by the exercises of early childhood, such as walking, running, and playing. The wound can, however, be almost perfectly protected by the application of a collodion dressing.

Operation having been decided upon, the testicle is pushed as near the scrotum as possible, and an inch and a half incision is made on the scrotal side of the testis and at right angles to the raphe, exposing the cord; by drawing upon this structure and by the use of retractors the testicle can be exposed and the fibrous adhesions binding it to its faulty position divided. Through the cellular tissue a way is then forced to the bottom of the scrotum; this pouch is invaginated into the wound, the base of the testis and the epididymis are secured to it by two or three sutures, and the perineal wound is sutured at right angles to its length, thus deepening the scrotal pouch.

Pubic and crural ectopy are so rarely found that their treatment by operative procedures has not been formulated. A testicle placed in front of the pubis at the root of the penis should be transplanted into the scrotum without difficulty.

In crural ectopy the testis should be reduced into the abdominal cavity, together with the hernia which usually accompanies it, and should be retained by a truss. Failing this, a protecting truss may be applied. If the testis is still subject to repeated attacks of inflammation, castration is generally advised, though from the surgical point of view there seems no good reason why the testis could not be placed in its proper position by freeing it and its cord and dividing Poupart's ligament.

Operations for the cure of undescended or ectopic testicles are advisable only in infancy and childhood, save under very exceptional circumstances. Later in life these misplaced testes will nearly always be partially degenerated and atrophied in consequence of the repeated inflammation to which they have been subject. The secreting substance usually disappears, and the testis remains an organ without functional activity, but vulnerable and liable to malignant degeneration. Castration is therefore advisable, and is particularly indicated because these testes are commonly complicated by hernia, and removal of the testis enables the surgeon to close completely the internal and external ring and the inguinal canal, thus insuring against recurrence of hernia. When the patient is possessed of but one testis, which is misplaced or ectopic, even though this has been repeatedly inflamed, every effort should be made to preserve it and to place it in its normal position. Routier, finding on operation that the testicles could not be brought into the scrotom, freed them and left them in the abdomen, giving the patient entire relief from his recurring attacks of inflammation.

Treatment of Complications of Misplaced Testicle.—Inflammation.—The general indications in the treatment of inflammation in an undescended or ectopic testis are those appropriate to a like condition of the normally placed gland. Rest in bed, elevation of the pelvis, moderate purgation, the application of heat or cold, depending upon the preference of the patient, and the relief of pain by hypodermic injections, represent the general line of treatment. When the inflammation ranges high and there is doubt in regard to diagnosis, there should be no hesitation in making an incision and exposing the gland, since the relief of tension thus secured is immediately followed by marked alleviation of pain. When the testicle is subject to recurrent attacks of inflammation, removal of the gland is the operation of choice.

Hernia.—When ectopy is complicated by hernia, and the latter exhibits a tendency to push the misplaced testis before it, thus favoring its descent, no retention apparatus should be applied until the gland has escaped from the external ring. A truss should then be so adjusted that it will keep the hernia from descending and push the testis still farther down. Unfortunately, cases are rare in which the hernia exhibits this tendency. More frequently it slips beyond the testicle, escaping through the external abdominal ring before the gland; a truss is then insupportable, and operation offers the only prospect of cure. If the patient is young and the testicle has not been repeatedly inflamed, the gland is brought to its normal position in the scrotum and the hernia is radically cured. After the age of puberty it is usually desirable to remove the testicle, entirely closing the rings and canal.

Malignant growth should be treated by early and complete removal. When the testicle is intra-abdominal this form of intervention is rarely practicable until the disease has become so well developed that there is no prospect of radical cure, since diagnosis cannot be made until a decided tumor develops. In inguinal ectopy enlargement of the gland may be detected early. Therefore operative interference promises better results. Whenever an undescended testicle increases in size without inflammatory phenomena, operation should be performed immediately. The removal of malignant testicle is usually unattended with operative difficulty.

Torsion.—The undescended testicle seems to be particularly subject to the accident of strangulation by torsion. When symptoms of extremely severe inflammation develop with unusual suddenness and severity and without obviously sufficient cause, incision and exposure of the undescended testis are indicated. The cord may be untwisted or the testis removed. The latter course is desirable, since testes subject to torsion are liable to undergo malignant degeneration.

Inversion of the Testicle.—The testicle, though it descend to the bottom of the scrotum, may assume various faulty positions termed inversions. This displacement may be anterior, horizontal, or lateral. The horizontal form is commonest. The testicle may be rotated completely, the epididymis lying in front, the free border to the rear.

No treatment is indicated in these cases, displacement being important mainly when surgical intervention is required,—for the cure of hydrocele, for instance. With this present in the case of anterior inversion, the testicle and epididymis would lie in front and not behind the fluid contained in the sac of the vaginal tunic: hence were a trocar introduced at the customary point it would wound both the testicle and the epididymis. The possibility of inversion is a reason for invariably examining hydrocele by transmitted light before tapping. Careful palpation, when the sac-wall is thick or the contents are turbid, will usually elicit the testicular sensation, suggesting the faulty position of the gland.

Monod and Terrillon advise that in tapping cases where the position of the testicle remains in doubt, the puncture should be made on the outer side of the scrotum instead of in front.

Of the other forms of inversion fewer cases have been reported, nor are they of much surgical importance. In the horizontal variety the long axis of the gland lies in the horizontal position, the epididymis looking upward. Lateral inversion is a modification of the anterior variety. Reversion of the testis has been reported by a few observers; the upper end of the gland looks downward.

Luxation of the Testicle.—The testicles may be displaced by direct traumatism or muscular action. The ordinary cause of this displacement is sudden violent contraction of the cremaster muscle reflexly excited in the course of a severe general muscular strain, following violence or without obvious cause. The testis may be fixed in the groin external to the ring from tonic spasm of the cremaster, may be lodged in the inguinal canal, or may be drawn even within the abdominal cavity; it is generally found within the inguinal canal. It shortly becomes inflamed and is subject to the general accidents already considered under the head of congenital displacement.

Treatment.—The treatment of luxated testicle is prompt replacement. This usually requires the administration of ether, since inflammation develops rapidly and the gland becomes excessively tender. If the testicle is held in its faulty position by adhesions or tonic contraction of the cremaster muscle, the operation for incomplete descent is indicated, the cremasteric fibres being cut through and the testis replaced and held to the bottom of the scrotum by sutures.

Torsion of the Testicle.—Torsion or axial rotation of the spermatic cord sufficiently describes the nature of this accident. It is one of sudden development, usually affecting the cords of undescended testes, though by no means confined to these. The cause of this twist has not been formulated; it is probably dependent upon congenital malformation, since Owen has pointed out that a testis properly placed in the scrotum and possessed of a normal mesorchium cannot be twisted. The twist may be either to the right or to the left, and in accordance with its extent and the degree of constriction to which the vessels are subject the symptoms are slight or severe. In slight cases the epididymis alone becomes infiltrated. In severe cases the entire gland with the epididymis becomes gangrenous, exhibiting extensive blood extravasations.

Symptoms.—The symptoms of torsion are those of epididymitis or orchi-epididymitis. They occur suddenly, often without apparent cause and during active muscular exertion. When the rotation is sufficient to produce complete strangulation the symptoms are violent and rapidly progressive. In cases of abdominal or inguinal retention the symptoms may be marked by those of a local peritonitis. The lesion has occurred in infants.

Diagnosis.—A positive diagnosis is rarely possible without direct exploration through an incision, the symptoms suggesting an excessively acute orchi-epididymitis or a strangulated hernia. Since torsion commonly affects an undescended testis,—this is often complicated by hernia,—the differential diagnosis may be extremely difficult. The inguinal tumor is painful, swollen, sometimes reddened and œdematous, and gives no impulse on coughing; it develops quite suddenly after exertion. Vomiting and tympany are by no means uncommon. These symptoms are so like those of strangulation—indeed, are so indistinguishable from this condition—that immediate exploratory operation is indicated.

When the testis occupies a normal position there is little likelihood of confounding a twist of the cord with hernia unless the latter has been a previous complication, since the cord can be felt above the swelling and the inguinal canal is free from hernial sac or contents.

The diagnosis of torsion will, then, depend mainly upon the suddenness of onset, the severity of symptoms, and the absence of other sufficient causes for acute inflammation. Moreover, the epididymis may be found in front of the testis, and in one case a nodulation corresponding to the twist was felt.

Prognosis.—If untreated, the testicle will either atrophy or become gangrenous; gangrene depending probably upon hæmatogenous infection of the devitalized area.

Treatment.—Reduction should be effected by manipulation or by operation. Rotation must be made in the direction opposite to that which is causative of pain.

When the patient is not seen early, and when the inflammatory phenomena are pronounced, incision is indicated. This should expose the testicle and cord. If the gland is black and gangrenous it should be removed. Otherwise the cord should be untwisted, one lateral surface of the testicle secured to the scrotum by several sutures, including the proper tunic of the gland and the deeper layers of the skin, and the wound closed. When the testicle is greatly swollen and discolored, even though it is not absolutely certain that gangrene has taken place, it is advisable to remove it if the testis on the other side is healthy.

The cases of hemorrhagic infarct reported by Englisch, and attributed by him to thrombosis of the pampiniform plexus, were possibly instances of torsion.

CONTUSIONS AND WOUNDS OF THE TESTICLE.

Contusion.—The testicles from their position and mobility usually escape the effects of sudden direct pressure applied to the region of the perineum and scrotum. They may, however, be pinched against the pubis or perineum or be bruised by a blow or a squeeze. The lightest form of contusion—such as that sometimes experienced in crossing the legs or riding the bicycle—is attended by momentary sickening pain, with a slight sense of soreness, which lasts not more than a day or two, and probably is not attended by distinct lesion, except in those who previously have been subject to latent disease, such as tuberculosis or tumor.

Monod and Terrillon, on the basis of an experimental investigation, classify testicular contusions as of three degrees: the first is characterized by minute disseminated capillary hemorrhages into the connective tissue lying between the seminal tubules and the convolutions of the epididymis. There is often epithelial exfoliation from the inner surface of the epididymis. Larger blood effusions characterize the second degree, and there is laceration of the tubules; the extravasations may vary from the size of a pea to that of a cherry. The third degree of contusion is characterized by rupture of the tunica albuginea. The gland is practically crushed, and there is bleeding into the vaginal tunic, with the formation of acute hæmatocele.

Symptoms.—These vary in accordance with the extent of injury. Slight contusions are characterized by a feeling of faintness, intense sickening pain, retraction of the testis, and rather rapid swelling. When the contusion is severe there may be profound shock or almost instant death.

The first exhausting, almost unbearable anguish is of comparatively brief duration. There follows a severe, unremitting ache, aggravated by standing, coughing, or straining. This persists until reactionary phenomena have reached their height, and is so harassing that anodynes are required for its relief. The swelling, which becomes perceptible within a very few minutes and develops rapidly, is due in part to effusion of blood and serum into the vaginal tunic, in part to œdema of the loose cellular tissue of the scrotum. Profound discoloration is common, and is caused by rupture of the vessels of the scrotum; exceptionally it is due to bleeding from the testis and epididymis or cord. The inflammation usually remains aseptic, reaches its height in from five to eight days, and subsides slowly. Exceptionally suppuration occurs. In this case, in place of subsiding, the symptoms increase in severity, the patient suffers from chill and fever, redness and œdema become especially well marked, and finally fluctuation is detected.

Prognosis.—In slight contusions, characterized by transitory pain and disability, lasting at most a few hours, the prognosis is favorable.

In the severer forms of contusion—*i.e.*, those putting a patient to bed for one or two weeks—an opinion as to the future integrity of the testicle should not be expressed too confidently. In a certain number of such cases atrophy develops, apparently uninfluenced by treatment. Atrophy may follow even slight bruises, and is most apt to occur during youth; the epididymis is usually spared. In the severest forms of contusion, characterized by rupture of the albuginea, atrophy is certain to result.

The atrophic processes may be progressive and uninterrupted, the testicle regaining its normal size on disappearance of the inflammatory swelling, and then continuing slowly to shrink, or the acute inflammation may be succeeded by a condition of chronic irritation, characterized by enlargement and tenderness and occasional attacks of pain. This chronic pain and swelling gradually subside, intercurrent subacute attacks becoming less pronounced, and the testicle ultimately wastes. This wasting may affect only a portion of the gland, producing asymmetry; but usually the whole organ is affected, there remaining when the process is completed a body of varying shape, about the size of a Lima bean or even smaller than this.

Prognosis is then always guarded, and becomes less favorable in proportion to the severity and the persistence of inflammation.

Treatment.—Even the mildest forms of contusion of the testicle should not be neglected, since exceptionally they are followed by chronic inflammation and atrophy. In severe injuries, shock and syncope are treated in accordance with general principles, and the agonizing pain is controlled by the injection of morphine. The patient should be placed upon his back, with the pelvis elevated and the scrotum supported either by a pillow placed close to the perineum or by a triangular handkerchief bandage, the base of which is passed beneath the scrotum, while its ends are secured to a band about the waist. To the injured testicle cloths kept constantly wet in lead water and alcohol are applied, omitting oiled silk, since this prevents the cooling effect of evaporation. A small ice-bag is even more efficient, and can be used for three or four days, a piece of lint being kept between its surface and the skin of the scrotum. If cold makes the pain more severe, hot compresses wrung out of dilute lead water and renewed every fifteen minutes may be employed, or lint soaked in this same lotion may be applied, and over it may be placed a hot-water bag.

The bowels should be opened freely, and when the swelling is so rapid and extensive as to threaten the vitality of the parts there should be no hesitation in cutting down upon and securing the bleeding points.

Discoloration incident to scrotal blood effusion should not be mistaken for gangrene. The patient should be kept confined to bed until the active inflammatory symptoms have subsided, and may then be allowed to get up, wearing the pressure suspensory bandage described in the section on the treatment of epididymitis. This bandage should be worn for months, and the patient should be cautioned against occupations or exercises liable to cause a recurrence of inflammation. Small doses of potassium iodide and application of mild counter-irritants to the skin of the scrotum are serviceable in relieving the chronic congestion which is liable to follow upon injury of the testis, and which is certain to result in deposition of fibrous tissue and subsequent wasting of secreting structure.

Epididymo-Orchitis from Strain.—This inflammation is properly considered under the head of contusion, since in a certain proportion of cases the symptoms are due to pinching or bruising of the testicle.

There develops, without a preceding urethritis and without obvious cause, a swelling which closely resembles in symptomatology and course either epididymitis secondary to gonorrhœa or traumatic epididymo-orchitis.

Terrillon records the case of a man who, in making a violent lifting effort, experienced a sudden pain in the left testicle so acute that he fainted. There was no contusion, no blood effusion. The testis was fixed in the left groin, and exhibited the tenderness, swelling, and pain of acute orchitis. Symptoms simulating localized peritonitis supervened, and lasted for eight days. The patient was confined to bed for three weeks. At the end of that time the testicle had atrophied until it was one-fifth its natural size; it was so tender that palpation could not be endured. The thigh was flexed, adducted, and rotated inward. As two months' further rest did not relieve the symptoms, castration was performed.

From careful observation of more than a dozen of these cases we believe that etiologically they can be classified as follows: 1. Epididymo-orchitis due to a violent contraction of the cremaster muscle, which by suddenly jerking the testicle against the pillars of the external ring causes a bruising of the former, often accompanied by rupture of the veins; this is called "whip-snap" action. When the external ring is patulous the testicle may be drawn within its grip and may be further bruised in this way. 2. Epididymo-orchitis from rupture of the veins. As a result of violent muscular effort and increased intra-abdominal pressure the often-dilated, valveless veins of the cord become enormously congested. This congestion is further increased by compression on the part of fibres which Roux states pass from the rectus muscle to the inner lip of the iliac crest. These fibres participating in the general muscular contraction pinch the cord against the fibrous circumference of the external abdominal ring. Rupture of vessels and bleeding into the cord, the epididymis, or possibly the substance of the testicle result. 3. Epididymo-orchitis from masked lesion. In a certain number of cases we have been able to trace the inflammation to infection passing from the posterior urethra along the vas; strain and possible slight contusion were undoubtedly favoring factors. The symptomatology and course of the inflammation were not different from those commonly observed in cases of chronic posterior urethritis. Twice we have observed acute tubercular epididymitis develop suddenly after muscular effort.

In accordance with the cause of the inflammation, variations in its clinical course are observed. There may be an acute epididymo-orchitis, such as that which follows ordinary traumatism, temporarily prostrating the patient and keeping him to his bed for days or weeks. The inflammation may be limited almost entirely to the epididymis and may run its course in a few days. Or there may be an almost painless enlargement, neither confining the patient to bed nor interfering with his occupation, provided a suspensory bandage is worn.

The left testicle is more frequently involved than the right; this is what would naturally be expected if the theory of venous rupture from pressure is correct.

Prognosis.—The prognosis of epididymo-orchitis from strain is much better than when external violence is the cause. When the lesion is simply hemorrhagic, the blood being found in the lower part of the cord and about the epididymis, with but slight congestion of the testicle, atrophy of this organ is not to be feared. When the inflammatory attack is limited chiefly to the testicle and is severe, there is wasting.

Treatment.—The treatment is that appropriate to contusion of the testicle. Even in the comparatively painless cases a properly fitted pressure suspensory bandage should be worn for a long period.

Wounds of the Testicle.—INCISED WOUNDS of the testicle if kept clean heal promptly. Such injuries are extremely rare, except in the course of surgical operations, particularly those undertaken for the purpose of establishing diagnosis. If the proper tunic is opened and the testis found healthy, the albuginea should be neatly apposed with catgut sutures and the external wound closed. Infection may be followed by prolapse of the secreting substance of the gland unless drainage is promptly established. In tubercular or syphilitic cases the so-called benign fungus may follow incised wounds.

PUNCTURED WOUNDS are usually inflicted by a misdirected trocar. Provided the instrument is clean, they are harmless. If a dirty instrument infects the testicle, diffuse acute orchitis may develop, with total destruction of the secreting substance.

CONTUSED AND LACERATED WOUNDS, usually inflicted by bullets, should be treated by thorough cleansing and abundant drainage. When it is evident that the testicle is extensively bruised, castration is probably the best treatment. When both testicles are involved in gunshot wounds every effort should be made to preserve even small portions of the secreting substance of the glands. This is usually practicable if the wound is kept clean. If suppuration takes place, complete atrophy will probably be the result.

Otis states that atrophy and neuralgia are common sequelæ of gunshot wounds of the testes when castration has not been performed.

On the first sign of infection after an attempt has been made to close a wound of the testicle, the stitches should be removed, the wound widely opened, and drainage secured by gauze packing.

After cleansing and closure of a wounded testis and the application of a proper dressing, the part should be elevated, and should be subjected to moderate pressure by means of a crossed of the perineum bandage. Outside the antiseptic dressing applied immediately over the wound is placed a sufficient quantity of cotton or crumpled gauze to equalize the pressure of the bandage. The bandage should be seven yards long and three or four inches wide. It is fixed by a circular turn about the pelvis, placed beneath the iliac crest. It is then carried downward along the right groin, across the perineum, around the back of the left thigh at the position of the ilio-femoral fold, upward over the trochanter and below the crest of the ilium, completely around the body until it is just above the left trochanter, down along the left groin, across the perineum, around the back of the right thigh at the ilio-femoral fold, and upward and forward over the right trochanter. These turns are repeated until a firm dressing is formed which entirely covers in the scrotum and perineum.

INFLAMMATION OF THE TESTICLE.

Inflammation may attack the epididymis, the testicle, or both these structures (epididymo-orchitis).

From the etiological stand-point the inflammations can be classed as blennorrhagic, traumatic, infectious, tubercular, and syphilitic.

Blennorrhagic inflammation is usually a pure epididymitis. The infectious inflammations are, as a rule, confined to the testicle. Traumatism more commonly produces a true orchi-epididymitis. Inflammation which attacks one structure primarily so frequently invades the other, and this invasion may be attended by such slight symptoms, that it is impossible from direct examination to be certain that the inflammation is strictly limited either to the epididymis or the testicle: hence the term orchi-epididymitis or epididymo-orchitis is often applied to this general class of inflammations.

Urethral Epididymitis.—Gonorrhœal urethritis is the commonest cause of epididymitis. So far as the clinical evidence is conclusive, there is reason to believe that the inflammation is almost entirely confined to the epididymis; it is probable, however, that during the acute stages the testicle is more or less involved. It is certain that the vaginal tunic is commonly inflamed, as is shown by the development of acute hydrocele, which may make up the main bulk of the swelling.

Epididymitis is a common sequel of instrumental urethritis,—for instance, that following the use of the lithotrite or frequent catheterization. It sometimes complicates gouty urethritis.

Epididymitis is an expression of infection carried by the vas, and may complicate any form of urethritis.

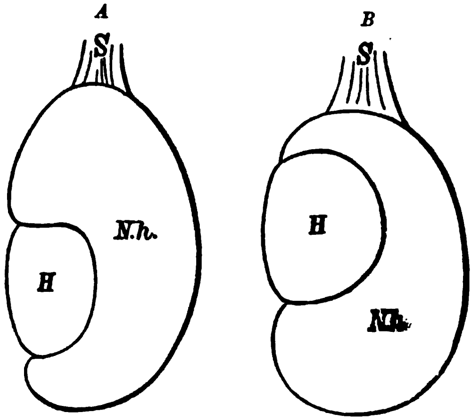
Symptoms.—The first prodrome which suggests the development of epididymitis is an aching, sometimes a neuralgic, pain felt along the line of the groin, often running down to the testicle, and made much worse by standing or walking. If the cord be taken between the thumb and finger and rolled so that its constituents are separated, the vas deferens may be found somewhat enlarged and tender on pressure. Sometimes there is neither tenderness nor enlargement of the cord to be detected. If the inflammation progresses, the epididymis becomes involved in one or two days at most.

Frequently the disease develops without any previous manifestations of involvement of the cord. Suddenly there will then be felt in the testicle a fixed, dragging pain. The epididymis increases rapidly in size, the scrotal covering of the affected testicle becomes œdematous and purplish in color, and pain is at times almost unbearable and of a peculiar sickening quality which renders it diagnostic. The anterior discharge is generally lessened; sometimes it entirely ceases for the time.

On palpation the epididymis is found to be sensitive and so much enlarged that it envelops the testicle above, behind, and below in a swelling more voluminous than the gland itself. (Fig. 197.) In the great majority of cases the inflammation extends to the tunica vaginalis and occasions an effusion of fluid, giving rise to an acute hydrocele; the latter entirely masks the testicles, so that on palpation a fluctuating tumor is felt in front, which is often incorrectly diagnosed as a swollen testicle, whilst behind is the enlarged, exquisitely tender epididymis.

The patient, unless the testicle is supported, walks with his body bent forward and his legs straddling,—a gait almost pathognomonic of the ailment. When he stands, free return of blood is prevented by the dragging of the tumor upon the spermatic vessels; this increases the tension and by additional pressure upon the nerves greatly aggravates the pain, which sometimes spreads reflexly to the bladder, perineum, rectum, back, abdomen, thighs, and even to the thoracic region, and is almost unbearable.

Fig. 197.



Showing the size and relative position of the testicle and epididymis in acute epididymitis. *H*, testis; *N.h.*, epididymis; *S*, cord. *A*, the swelling is most marked about the head of the epididymis; *B*, the swelling is most marked about the tail. (Kaufmann.)

There are usually rigors, fever, and great mental anxiety and depression.

Sometimes acute epididymitis in its onset is characterized by symptoms so violent and apparently so disconnected from the testicle as readily to occasion a mistaken diagnosis. In these cases there will develop, often in connection with a posterior urethritis fanned to new intensity, violent abdominal pains, accompanied by tympany and extreme sensitiveness in the lower part of the belly; fever runs high, and nausea, green vomiting, and collapse may follow. These symptoms subside almost as quickly as they develop, and are followed by the ordinary symptoms of epididymitis. The disease usually reaches its height in about five days.

The clinical course of epididymitis varies greatly in individual cases. Some patients experience only moderate dragging pain, which does not incapacitate them, and exhibit a somewhat sharply circumscribed tumor in the tail of the epididymis, with possibly slight hydrocele, and a little reddening and induration of the scrotal skin overlying the seat of hardening. In the majority of cases the pain, though severe, is relieved by a properly fitting suspensory bandage, and the patient is not forced to take to his bed. The swelling is, however, usually very marked, being made up in the main of inflammatory infiltration in the loose cellular tissue surrounding the lower portion of the cord and covering the epididymis, but not included in the reflection of the tunica vaginalis. The redness and œdema of the posterior aspect of the scrotum are marked, and there is commonly a very appreciable degree of hydrocele present, which instead of being general may be encysted from inflammatory adhesions. Exceptionally the onset of the disease is sudden, the pain violent, the constitutional symptoms pronounced, the patient unable to stir from his bed. In these cases the local symptoms are usually exceedingly well marked, tenderness, swelling, œdema, and either encysted or general hydrocele are present, and often accompanying the inflammation of the epididymis there is a funiculitis characterized by a tender, thickened condition of the vas, which can be felt on palpation, or by inflammatory infiltration of all the structures of the cord, forming a doughy, sausage-shaped tumor thicker than the thumb and extending up into the inguinal canal. On rectal examination the thickened tender vas can often be felt very distinctly. When the funicular portion of the tunica vaginalis has not been obliterated there may be formed a true hydrocele of the cord. Finally there are cases which, though not exhibiting especially severe local symptoms, are characterized by reflexes which so strongly suggest general peritonitis that they usually occasion grave anxiety until the local symptoms of epididymitis become well established. Exceptionally, when the testicle and its epididymis are not normally placed, an acute epididymitis may lead to an error in diagnosis. Thus, when the testicle is retained within the inguinal canal the early symptoms may readily simulate those of a strangulated hernia. An examination of the scrotum, by showing the absence of the testicle from its normal position, would at once suggest the diagnosis.

The pathological changes incident to epididymitis consist of a catarrhal inflammation of the vas and epididymis, associated in severe cases with œdema and round-cell infiltration of its walls and the surrounding loose connective tissue. In the tail of the epididymis are often found what appear to be foci of pus. These are in reality contained in the seminal canal, and are made up of muco-pus and the secretion of the testicle.

Prognosis.—The prognosis of epididymitis is good, although cases are reported in which life has been lost from extension of the inflammation to the peritoneum. These are extremely rare. The disease may undergo complete resolution; exceptionally suppuration occurs. Commonly the inflammatory infiltrate, instead of being completely absorbed, organizes in part, and forms a hard nodule in the tail of the epididymis which obliterates the efferent duct of the testicle. Exceptionally there is a permanent thickening of the entire epididymis. The hydrocele not infrequently becomes chronic. Suppuration is denoted by increased severity of the local inflammatory symptoms, by rigors and sweats, and finally by fluctuation. On opening the abscess, prolapse of the entire epididymis sometimes occurs; when the suppurative inflammation has involved the testicle proper, this may be entirely destroyed in a short time by rapid extension of the trouble; or the suppurative process may become chronic and slowly extend, finally resulting in destruction of the gland. Except in suppurative cases the testicle is rarely involved in epididymitis, and hence is not materially altered even though its efferent duct is entirely blocked. Very rarely after the cure of a specially severe epididymitis the testicle slowly atrophies. In this event it is probable that the inflammation extends to its structure, and as the infiltrate becomes organized and exercises pressure the glandular substance atrophies and is absorbed. Even though the inflammation undergoes apparent resolution it may cause the development of latent tuberculosis.

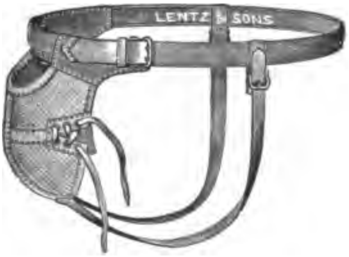
The prognosis in regard to sterility is, of course, good when but one testicle is affected, though even then it has been noted that spermatozoa disappear entirely from the semen during the height of an attack. When the epididymitis is bilateral the prognosis must be more guarded, though most of these cases recover with functional testicles. In a certain proportion, however, especially in those not carefully treated, the epididymis of both sides becomes obliterated and the patients remain sterile. When the sterility is of long standing it can be helped only by operation. (See Sterility.) Impotence is never a direct consequence of epididymitis.

Pure gonorrhœal epididymitis is much less likely to suppurate than that which results from instrumental infection, and this is in accordance with the rule governing gonorrhœal inflammations,—*i.e.*, that they are formative rather than suppurative. Suppuration is comparatively common in instrumental epididymitis.

The hard nodule left in the globus minor after gonorrhœal epididymitis rarely disappears entirely. In attacks of moderate severity it may be impossible after a time to decide which testis was inflamed, but years after a severe attack an examination will usually detect either a fibroid mass or distinct nodular induration. These indurations are more extensive and more persistent in the epididymitis secondary to non-specific posterior urethritis. Except during or shortly after an acute inflammatory period, treatment of these fibrous nodules is futile. The nodulation probably renders the individual sterile so far as that single gland is concerned, but it does not attract his attention or arouse his anxiety, and is therefore not the cause of hypochondriasis or neurasthenia, as otherwise it would be in the greater number of cases. With the exception of the testes, all glands atrophy when their ducts are completely obstructed. Curling, Hunter, Gosselin, and others have long since shown that the vas may be obliterated without affecting the development or health of the testicle. White and Kirby have recently demonstrated the same fact experimentally.

Treatment.—Prophylaxis consists in the continued administration of antiseptics by the mouth, the proper use of carefully chosen antiseptic injections or irrigations, and the avoidance of intercourse, muscular strain, or excesses of any kind. The wearing of a suspensory bandage is advisable. On the first prodromal symptoms—*i.e.*, those of seminal vesiculitis, or dragging pain in the inguinal region, or tenderness and swelling along the cord, best detected by rectal examination—the patient should be put to bed, the bowels should be freely opened, preferably by a saline, the testicles should be wrapped in lead water and laudanum, and elevated by a properly applied handkerchief bandage, and hot compresses and a hot-water bag should be applied to the inguinal region. These will usually limit the inflammation to a funiculitis, especially when the treatment appropriate to a posterior urethritis has been prescribed. In the mild and moderately severe cases which do not apply for treatment until the inflammation of the epididymis is pronounced, a properly fitted suspensory bandage will usually relieve pain at once and bring about rapid resolution without requiring the patient to take to his bed. The bandage employed is a modification of the Langlebert-Horand, and brings to the relief of inflammation the most potent remedies at the command of the surgeon,—namely, heat, moisture, rest, and pressure. (Fig. 198.) The body of the suspensory is made up of mackintosh, which is, in turn, lined with stout cloth. The bag of the bandage is shallow, and at the sides are gores which are provided with eyelets and laces. When a bandage of proper size is applied and strapped tightly it not only presses the testicles upward against the soft parts lying anterior to and just below the pubes, but by the lacings also exerts lateral pressure, so that these

Fig. 198.



Epididymitis suspensory bandage.

glands are evenly and everywhere supported. The method of applying this bandage is as follows. The patient is placed in a recumbent position, and the testicles and scrotum are held up for four or five minutes, thus reducing congestion as much as possible by position. The whole scrotum is then enveloped in a thick sheet of absorbent cotton or wool. Outside of this the suspensory bandage is applied. It is strapped on tightly, and is then laced at the sides. When the appliance is properly fitted, relief of pain is almost immediate and is usually permanent, and resolution takes place promptly.

In the severe cases, those developing suddenly with great swelling and agonizing pain, relief may sometimes be given by puncturing with a narrow-bladed knife the vaginal tunic and the infiltrated cellular tissue at the back of the scrotum. This operation must be conducted under antiseptic precautions. It may be rendered painless by the preliminary injection of a few drops of cocaine, and should be performed with a straight, narrow-bladed knife, the latter being driven in at the point where the swelling, redness, œdema, and tenderness are most pronounced, usually at the back of the scrotum and at about the middle of the epididymis. The knife should not be carried to a depth greater than half an inch, since it is inadvisable to puncture the tunica albuginea. Following puncture there is usually the escape of a few drops of serum, which generally spurts out as if under considerable pressure, with almost immediate lessening of pain. The seat of puncture should be covered with a small antiseptic dressing, held in place with collodion, after which the pressure suspensory bandage above described may be employed. If this fails to give relief, the scrotum should be elevated by means of a handkerchief suspensory bandage folded in the form of a triangle, with its base placed beneath and behind the testicles and its two ends carried up over the front of the belly and secured to a band about the waist. By carrying the third corner of this triangle upward and securing it to the waistband the testicles are kept effectually elevated. They should be swathed in lint kept constantly wet with lead water and laudanum equal parts, or with the following mixture:

℞ Tinct. aconiti,
Tinct. opii. āā f℥i;
Liq. plumbi subacetatis,
Aquæ, āā f℥ii.
M. S.—For external use.

If the pain is unrelieved the hair should be shaved over the groin of the affected side, and six ounces of blood should be taken by means of leeches applied along the line of the cord, but above the limits of the scrotum. Each morning the patient should take half a bottle of effervescing magnesium citrate. Hypodermic injections of morphine are usually required in severe cases. When these are distinctly contra-indicated and other means of relieving pain have failed, Roussy, on the basis of experience with thirty-four cases, advises subdural injections of three to four cubic centimetres of a one per cent. solution of cocaine. The technique of this injection is that employed in the treatment of incontinence of urine. (See page 326.) Conditions that would justify its employment are of the greatest rarity. The diet should be restricted, and the fever should be combated by potassium bromide five grains and tincture of aconite one drop, given every two hours. In the suppurative cases incision should be made as soon as the presence of pus is demonstrated, and drainage should be provided for by packing with iodoform gauze.

When the acute inflammatory symptoms have subsided,—*i.e.*, when the pain has lessened and is severe only upon motion, and the epididymis and the surrounding cellular tissue form a large solid mass,—pressure is always indicated. This is best applied by means of a suspensory bandage, as already described, or through the medium of a strip of rubber dam eight to ten inches long and half as wide. The testicle is tightly encircled in this bandage, the final turn of which is secured by a strip of adhesive plaster. From the very beginning of the attack when a sweating suspensory bandage has been used a twenty to fifty per cent. guaiacol ointment spread on lint and applied within the suspensory serves as a useful counterirritant.

When all inflammatory swelling has disappeared, but an indurated nodule persists, the pressure suspensory bandage should still be employed in conjunction with an ointment made of belladonna ointment and mercuric ointment equal parts, and internally five grains of potassium iodide should be given three times a day.

The treatment of all forms of epididymitis due to extension of inflammation from the posterior urethra is conducted on the lines laid down in regard to the gonorrhœal variety. Urethritis which is intensified by gout should be subjected to antilithæmic remedies, and appropriate diet and hygiene should be ordered. The harassing recurring epididymitis from which prostatics who are compelled to pass the catheter suffer should be prevented by vasectomy, and the operation should be performed for the relief of all forms of recurring epididymitis of urethral origin when the patient is past the procreative age. For the operative cure of sterility following double obliterating epididymitis, see page 802.

Epididymo-Orchitis complicating Acute Infectious Diseases.—Under this general heading are included orchitis of mumps, variola, typhoid, malaria, scarlatina, influenza, and possibly gout. Inflammation in most of these cases is of pure hæmatogenous origin, dependent upon toxic substances circulating in the blood. It apparently attacks primarily and most severely the testicle. When the disease develops in its acute form the symptoms are even more marked than those of acute epididymitis. In the latter affection the bulk of the tumor is formed by the epididymis, which partly envelops the testis as would a hand a small kidney. In orchitis the main swelling is formed by the testicle, this gland, even though enormously swollen, maintaining its normal form; the epididymis if uninvolved is stretched as a narrow band along its posterior border. The general testicular sensibility is greatly increased. In epididymitis the tenderness is limited mainly to the epididymis itself. Acute hydrocele may occur coincidently with the swelling of the testicle, but is much less common than when the epididymis is involved. Exceptionally suppuration ensues; this is nearly always preceded by great œdema and discoloration of the scrotum and by pronounced constitutional symptoms.

The differential diagnosis between orchitis and epididymitis is based mainly upon the form of the swelling. When the tissues of the scrotum become markedly œdematous, and particularly when hydrocele develops, a differential diagnosis may be impossible; nor is this of cardinal importance.

ORCHITIS COMPLICATING MUMPS.—Inflammation of the testicle is sometimes the sole expression of mumps; it runs an acute course, terminating in a few days or a few weeks.

It may be ushered in by a rise of temperature, and generally develops from the fourth to the sixth day of the disease. As a rule, only one testis is involved. Catrin, basing his conclusion on a study of one hundred and fifty-nine cases of mumps, states that orchitis occurs in one out of three cases, usually develops after the parotiditis, and begins in the epididymis, the body of the gland being subsequently attacked. Atrophy of the organ is rarer than is usually supposed. In a certain number of cases after a period of atrophy and loss of consistency the testicle regains its original volume and firmness. If both testes become involved the inflammation is usually consecutive.

In contradiction to the statement above quoted, we believe that the inflammation of this form of orchitis begins in the gland and not in the epididymis, and that incurable atrophy is a much commoner sequel than is generally conceded. Hornus observed a fatal case of orchitis consecutive to mumps. Death was caused by peritonitis, the testicles having been absolutely destroyed and converted into a purulent collection.

As to the etiology of the testicular affection, the theory of metastasis is absolutely inadequate, since it really gives no explanation, but merely a word to describe what is not understood. Kocher states that orchitis after mumps is urethral, the specific inflammation excited by the organism first involving the urethral mucous membrane and then extending along the vas. If this were true, we should expect the inflammation to develop first in the epididymis, as in the case of most inflammations of urethral origin. With the exception of Catrin, authors generally teach that the testis is primarily involved. The symptoms of mumps orchitis are pain, swelling, exquisite tenderness, and fever of moderate degree. Exceptionally the attack is ushered in with typical symptoms of acute peritonitis,—*i.e.*, vomiting, constipation, tympany, and peritoneal tenderness; still more rarely by acute nephritis with uræmia.

Diagnosis.—The diagnosis is founded upon associated symptoms of parotiditis, or, in the rare cases when these are latent or absent, upon the possibility of contagion and the exclusion of other sufficient causes of inflammation.

Prognosis.—This, we think, should always be guarded. In light attacks characterized by moderate swelling the prognosis is doubtless favorable. In severe attacks with pronounced general symptoms, and especially when the attack is prolonged, atrophy is always to be dreaded.

Treatment.—The measures already described as appropriate to orchitis and epididymitis are indicated when the testis becomes inflamed as an expression of mumps.

As a prophylactic treatment in all cases of parotiditis it is well to support the scrotum by a soft flannel binder or a suspensory bandage, in accordance with the age of the patient. Moreover, since this is an infectious disease, as illustrated by the formation of erythematous nodules, involvement of the kidneys or meninges, the development of various inflammations, dysentery, vomiting, and the general symptoms of infection, it would seem wise to administer salol and boric acid, with the purpose of rendering the urine slightly antiseptic and thus preventing inflammation of the posterior urethra which might extend along the vas. The comparatively unyielding tunica albuginea subjects the secreting substance of the testis to fatal pressure when inflammation is pronounced or is of long standing. This can be relieved at once by incision or puncture. The profession has been deterred from this form of intervention by the fear of hernia testis,—*i.e.*, extrusion of the secreting substance of the testicle. When this has occurred it has been in consequence of infection; even though a certain amount of testicular substance should be lost as a result of incision, it is probable that the ultimate functional power of the organ would be better than it is when tension has been unrelieved.

TYPHOID ORCHITIS is commonest before the age of puberty. As a rule, it is mild in type and occurs during convalescence. It is not definitely settled whether the testis or the epididymis is primarily involved. The etiology of this condition is sometimes dependent on venous thrombosis, though it may be the result of infection from the urethra or through the agency of the blood. The typhoid bacillus has been found in suppurative cases. Atrophy is rare.

MALARIAL ORCHITIS.—This form of inflammation is chronic in type, with acute paroxysms, sometimes recurring regularly. In one case we noted acute pain and exquisite tenderness developing daily with the regularity that characterizes a quotidian type of malaria. The condition yielded promptly and completely to full doses of quinine.

Le Dentu states that the testicle slowly increases in size, becoming elephantiasic. He describes a form of overgrowth associated with elephantiasis of the scrotum and evidently dependent upon involvement of the lymphatic system. This is characterized by recurrent erysipelatoid attacks, with gradual deposition of partially organized fibrous tissue. It is probable that this is not malarial orchitis, but a distinct affection.

The principal diagnostic features of malarial orchitis are the recurrence of attacks and the absence of other sufficient cause for the symptoms. Full dosage with quinine will establish the diagnosis and relieve the condition.

ORCHITIS FOLLOWING TONSILLITIS is an expression of infection which may be hæmatogenous or may be carried from the urethra. The course of the affection is similar to that of orchitis complicating mumps. The disease lasts two or three weeks and usually terminates in resolution, but may suppurate or become chronic, in either case ultimately causing atrophy.

GOUTY ORCHITIS is found associated with the usual phenomena of gout. It may be acute or chronic in type, and is likely to be persistent. It may, however, alternate with other gouty symptoms, disappearing with the arthritis and reappearing as the latter subsides. It is prone to relapse, occurring in sudden seizures, and may be transferred from one testicle to the other. True gouty orchitis is quite different from the epididymitis of urethral origin observed in gouty persons. It occurs after middle life, and affects primarily and chiefly the testes, rarely extending to the epididymis.

ORCHITIS FOLLOWING SMALL-POX, SCARLATINA, OR INFLUENZA has no pathognomonic features. It is simply a local expression of a general infection, due either to lodgement of micro-organisms circulating in the blood or to extension by means of a phlebitis, especially of the spermatic veins.

TRAUMATIC ORCHITIS has been already discussed.

By whatever cause orchitis or orchi-epididymitis is excited, the lesions, symptoms, and terminations are practically the same, with minor differences dependent upon a difference in the virulence of the infection and upon varying individual power of resistance. The distinction between inflammations of urethral and those of hæmatogenous origin is important mainly from a therapeutic stand-point, since a posterior urethritis if present should receive attention.

The inflammation may terminate in complete resolution with restoration of physiological function, in chronic inflammation followed by atrophy and loss of function, or in abscess often complicated by fungus of the testicle. Gangrene is a rare complication occurring in debilitated patients. Exceptionally the inflammation extends along the cord, occasioning pelvic cellulitis and peritonitis. We believe, however, that most of the reported cases of this extension are in reality instances of suppuration of the seminal vesicles. The initial cause of chronic inflammation is usually a preceding acute orchitis, although underlying this there is often a constitutional dyscrasia. Either the testicle becomes indurated and completely atrophies, or suppuration takes place, producing multiple abscess.

Treatment.—Acute orchitis is treated by the remedies and applications described as appropriate to gonorrhœal epididymitis. The indications are met by rest in bed, elevation of the pelvis and the testicles, the application of evaporating lotions or the ice-bag, or hot fomentations, according to the severity of the inflammation, securing a soluble condition of the bowels, and the administration of febrifuges and diuretics, and of morphine hypodermically in sufficient doses to control the severe pain.

If the pain is so intense that safe doses of morphine will not relieve it, the tunica albuginea may be punctured. The punctures should be made with a straight cataract knife; they may be multiple and may be repeated several times. The importance of guarding against infection is evident. Abscesses should be opened and drained by gauze packing; rheumatic and gouty cases should receive appropriate constitutional treatment, and invariably on the subsidence of acute inflammation the general treatment of the patient should be tonic and supporting.

As soon as patients are able to leave bed, and when the inflammation is moderately severe this should not be under two or three weeks, a carefully fitted pressure suspensory bandage should be worn, preferably that described in the treatment of gonorrhœal epididymitis, and this should be continued for months or until the testicle returns to its normal condition. At the same time a slightly stimulating ointment applied to the scrotal skin will be serviceable. One reason that acute orchitis and orchi-epididymitis run into the chronic form and produce slow destruction of the secreting portion of the testes is that patients are allowed to be up and about before the blood-vessels have regained their tonicity, and hence there results a condition of chronic congestion in a previously inflamed organ. Prolonged rest in bed and an accurately fitting pressure bandage are the means of treatment which offer most hope of avoiding this complication.

Abscess of the Testicle.—Reference has been already made to abscess as a comparatively rare termination of acute or chronic orchitis and epididymitis. In tubercular, malignant, or syphilitic degeneration of the testes pus-formation is common. In gonorrhœa and mumps it is rarer than in other acute infectious diseases. It is probably most frequent in the epididymo-orchitis which develops in old men in consequence of catheter urethritis.

A small abscess having formed in the testis, it may become encysted, undergoing caseous degeneration; or may spread beneath the tunica albuginea, involving the whole testis and causing sloughing, followed by many openings; or may rupture into the tunica vaginalis, causing suppuration of this sac and ultimately pointing externally; or the abscess may reach the surface without rupturing into the cavity of the tunica vaginalis, inflammatory adhesions gluing all the tissues together before the pus breaks through the tunica albuginea.

Sometimes the abscess when centrally placed may remain quiescent for an indefinite period, occasionally exhibiting acute exacerbations. It should be remembered that gangrene of the testis may occur as a consequence of a very small abscess.

The *symptoms* of suppuration are those of an aggravated orchitis. Usually there is fever and the œdematous swelling of the scrotum becomes more pronounced. Following incision or spontaneous evacuation, fungus of the testicle may develop, the whole of the secreting substance of the gland being extruded.

Treatment.—Early free incision, followed by irrigation and gauze packing, is the treatment best calculated to relieve tension, and therefore to lessen the danger of acute tissue necrosis. Healing is usually prompt. When the whole testis is riddled with abscesses, or when sloughing has taken place, castration is the operation of choice.

Gangrene or Necrosis of the Testicle may be due to thrombosis or endarteritis of the spermatic artery, torsion of the spermatic cord, or hyperacute inflammation of the gland. Castration is indicated.

Fungus or Hernia of the Testicle.—There are two varieties: (1) true or glandular fungus, made up of a mass of granulation-tissue, which sometimes contains seminiferous tubules, growing from within the tunica albuginea; (2) false or parietal fungus, consisting of exuberant granulations springing from the tissues of the scrotum or from the surface of the tunica albuginea.

Fungus of the testicle may be caused by suppuration, gangrene, syphilis, or tuberculosis. Reclus states that hernia of the testis implies protrusion of the gland still covered with its fibrous envelope through an opening in the scrotum. Scrotal tuberculosis, inflammation, gangrene, and traumatism may destroy the scrotum and allow the testicle to protrude.

The older writers described a hernia testis apparently due to simple infection following, for instance, such a procedure as puncture of the tunica albuginea for relief of pain in a gonorrhœal epididymitis. We have once encountered such a condition which was neither tubercular nor syphilitic, but was an instance of sloughing testis, in which the devitalized tissues gradually escaped though an infected and bruised trochar opening.

Fungus which accompanies suppurative or sloughing processes may be made up entirely of granulation-tissue. This is always the case in the parietal form of the affection. In the glandular or deep form the tubular structure of the testis is often extruded, though absence of the tubules in the slough and discharge does not prove that the granulations do not grow from the gland.

The tubercular fungus may be superficial or deep, and is made up of exuberant granulations from the walls of an abscess. These protrude through openings in the scrotum which exhibit indurated, chronically inflamed, gradually contracting borders; they appear as yellowish-red, painless, cauliflower-like growths, overlapping the scrotal defect, rarely larger than the end of the thumb, though in the glandular variety the greater part of the testicular substance may be extruded.

The syphilitic fungus grows from the walls of a discharging gumma; it may be intra- or extra-glandular; it rarely attains the size of the larger tubercular fungus.

The malignant fungus (fungus hæmatodes) is in reality a new growth which has broken through the tissues of the scrotum.

Diagnosis.—The appearance of an irregular, red, granulating mass protruding through an opening in the scrotum is so characteristic of fungus that the diagnosis is formulated on sight. The nature of the growth may, however, require careful study. The history of the case, particularly that of the development of the preceding orchitis, is usually characteristic. The finding of the seminiferous tubules and the detection of a distinct pedicle to the growth show that it originates from the glandular substance.

Treatment.—This depends upon the cause and the variety of the fungus. Syphilitic cases are cured by appropriate constitutional treatment, supplemented by cutting away the exuberant granulations and dressing the wound with sterile gauze. Tubercular cases, if superficial, may be cured by touching with caustic potash and dressing with iodoform gauze. If deep, they should be opened, curetted from the bottom, and packed; if persistent and associated with extensive degeneration of the testicle, castration should be performed. Fungus hæmatodes (malignant) should be treated by castration.

The fungus which complicates simple abscess or sloughing, and which springs from the glandular substance, being made up of granulation-tissue and sometimes of seminiferous tubules, should be opened and curetted and the resulting wound packed with iodoform gauze.

TUBERCULAR DISEASE OF THE TESTICLE.

Tubercular inflammation may develop in one of two forms: either as a sudden outbreak with all the local and general symptoms of acute inflammation, leaving on subsidence an irregular nodulation characteristic of tuberculosis, or as a slow, apparently non-inflammatory, almost painless formation of tubercular nodules.

The infection may reach the testicles through the blood-channels or may extend by continuity of structure along the vas. Occasionally the testicles and the epididymis are affected during the evolution of a general miliary tuberculosis. The lodgement of the tubercle bacilli may be primary in the epididymis, or the infection may be secondary to prostatic, vesical, or renal tuberculosis, or to foci of the disease in other parts of the body.

So far as clinical evidence goes, the epididymis appears to be a frequent seat of primary tuberculosis; from this organ as the starting-point the disease extends along the genito-urinary tract. Saltzmann defends the theory of the entrance of the bacilli by way of the blood-vessels on the ground that the arteries of the epididymis are smaller and more tortuous than those of the testicle or of the vas, and that thus bacilli floating in the blood are more liable to be lodged. Moreover, the spermatic artery bifurcates just before it enters the epididymis.

It is possible that infection may take place during coitus. Verneuil strongly defends this theory. He demonstrates the presence of tubercle bacilli in the discharges of patients suffering from uterine tuberculosis. He also cites cases in which the disease—*i.e.*, tubercular epididymitis—appeared in persons of perfectly healthy constitution after sexual intercourse and where no gonorrhœal history existed. Further, the tubercular infection is most likely to develop at that age when sexual activity is greatest, and in the early stages of genital tuberculosis there is no interference with sexual desire or potency. This belief in immediate tubercular contagion is sufficiently well grounded to justify a careful examination of uterine and vaginal discharges in suspected cases, and, when bacilli are found, to make it desirable to suggest means of prophylaxis.

Tubercle bacilli have been found in the healthy testicle and epididymis. It is also proved that these organisms may circulate in the blood without obtaining lodgement in the tissues, and consequently without working deleteriously upon the system until acute inflammation, particularly that following traumatism, produces a local lessening of resistance which favors the lodgement and multiplication of the micro-organisms. This has been shown experimentally by intraperitoneal injection of tubercular sputum followed by contusion of the testis, and it explains the frequency with which an acute gonorrhœal epididymitis or an orchitis incident to traumatism is followed by a tubercular infiltration.

In the large majority of cases tubercular infiltration is first noted in the head of the epididymis, appearing as inflammatory nodules which sooner or later undergo cheesy degeneration. The epididymis becomes irregularly infiltrated, and the vas thickened, hard, and nodular. The disease also extends in the direction of the testis, and not infrequently the vaginal tunic is involved. When the testis is infected, similar nodules develop and show a central degeneration, extending at the same time peripherally, and finally forming a comparatively large cavity.

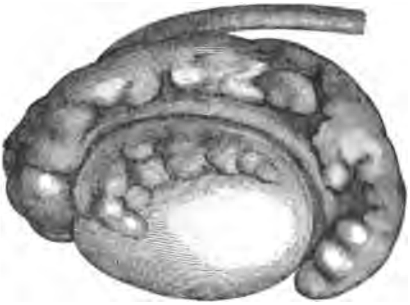
Though from clinical examination in the vast majority of cases tuberculosis seems primarily to involve the epididymis, entirely sparing the testis, Reclus has shown by post-mortem dissection that both epididymis and testis are involved in more than three-fourths of the cases. In twenty-two cases in which no autopsy was made, tubercles were palpably present in the epididymes and testicles in ten cases, and only in the epididymes in twelve cases.

Symptoms.—Tubercular epididymo-orchitis may develop abruptly or insidiously, or may be preceded by certain highly characteristic prodromal symptoms.

The abrupt development of the disease is usually dependent upon slight trauma or extension of inflammation from posterior urethritis. The symptoms are practically the same as those of traumatic orchitis or of gonorrhœal epididymitis. There are the characteristic sickening pain, effusion into the tunica vaginalis and the cellular tissues about the epididymis, and general œdema. Instead of subsiding in the course of a few days or one or two weeks, the local swelling persists, though pain may be almost entirely relieved. In a few weeks fluctuation may be detected, and one or more sinuses form, discharging cheesy pus.

This inflammation is commonly an epididymo-orchitis, and is often bilateral. It attacks by preference young adults, and is first lodged in the epididymis, the outlines of which are so obscured by a large bossed swelling that the loop formed by the vas deferens cannot be felt (Reclus); the vas is often infiltrated, and there is generally tubercular involvement of the other genito-urinary organs, particularly the prostate and seminal vesicles. Except during the period of acute outbreak there is little or no pain. Fistula may not form for a long time, the acute swelling partially subsiding and allowing the nodular, indurated, and enlarged epididymis and vas to be readily palpated. Hydrocele generally develops in connection with this form of tuberculosis, and is likely to be of the agglutinative type. In the discharge from the sinuses tubercle bacilli may be found.

FIG. 199.



Tubercular epididymitis. (Monod and Terrillon.)

The insidious form of the disease is characterized by the slow, painless formation of nodules either in the epididymis or in the testicle, or in both these organs. (Fig. 199.) Often there are absolutely no symptoms, the patient detecting the overgrowth accidentally. Sometimes there is a sense of dragging and weight, or there are reflex disturbances, such as frequent emissions or sexual hyperæsthesia, which lead to examination of the part and discovery of the swelling.

The form of the disease ushered in by prodromata is probably not primary,—*i.e.*, there is a pre-existing tubercular involvement of some other portion of the genito-urinary tract. The prodromal symptoms are—(1) A painless, moderate urethritis, characterized by a scanty, turbid, muco-purulent discharge, noticeable only in the morning. This discharge comes and goes apparently without cause, and is uninfluenced by treatment. (2) Frequent urination. (3) A hypersensitive condition of the prostatic urethra, particularly to instrumental examination and irritating injections. (4) Terminal hæmaturia. These symptoms may last weeks or months before appreciable development of lesions in the testicle or the epididymis, and indicate tubercular involvement of the posterior urethra.

In the chronic forms of tubercular involvement of the testicle and epididymis suppuration and abscess-formation develop much more slowly than in the acute. Even large infiltrations become encapsulated and absorbed, leaving simply an irregular fibroid nodulation. We have under observation cases of tubercular epididymo-orchitis which have lasted from four to eight years, which in place of softening and breaking down have been undergoing a steady fibroid change. When fistulæ are formed, usually in the lower posterior part of the scrotum, they continue to discharge a thin serous fluid, often containing broken-down granulations, until the degenerated tissue is entirely eliminated; they then heal, unless there is extension of infiltration.

Diagnosis.—The diagnosis of acute tubercular epididymo-orchitis is based on—(1) The apparently causeless outbreak of acute inflammation. When traumatism, mumps, gonorrhœa, syphilis, and the various infectious diseases can be excluded, tuberculosis should be suspected. (2) The presence of tubercular infiltration in the prostate or seminal vesicles or evidences of infection in other parts of the body. (3) Persistence of swelling after the pain and other symptoms of acute inflammation have subsided. (4) Formation of nodules, particularly in the region of the epididymes, which soften and break down, leaving fistulæ, in the discharge of which may be found tubercle bacilli.

Acute tubercular epididymitis commonly develops in young adults of lymphatic temperament who have a tubercular family history. The pain and swelling are somewhat less marked than in cases of gonorrhœal epididymitis, for instance. It must be confessed that in the first one or two weeks of an attack it may be impossible to establish a diagnosis. The formation of suppurating nodules is, however, characteristic. The cord is soon involved, becoming thickened and irregularly bosselated.

The diagnosis of chronic tubercular epididymo-orchitis is based upon a tubercular history, the painless, non-inflammatory development of infiltration, particularly in the head of the epididymis, the association with non-gonorrhœal urethral discharge, frequent urination, and hæmaturia, the discovery of induration or nodulation of the seminal vesicles or prostate, the gradual extension of the infiltration to the entire epididymis and to the cord, often forming an irregular tumor much larger than the testicle, and finally upon the tuberculin test and bacteriological examination. When there is an associated hydrocele (and this is common), injection of this fluid into the peritoneal cavity of rabbits may in tubercular cases cause the development of miliary nodules. The urethral discharges should be carefully examined for tubercle bacilli. It must be remembered that it is possible for gonorrhœal epididymitis to develop and run its typical course in the tubercular subject without subsequent tubercular infiltration of the epididymis or testis.

Differential diagnosis between the tubercular nodule and the induration following gonorrhœa is based upon the history of a preceding acute urethritis and upon the fact that the gonorrhœal induration is found in the tail of the epididymis, while the tubercular nodule is usually in the head. The gonorrhœal nodule exhibits no tendency towards extension, does not mask the outlines of the epididymis, and is not associated with palpable lesions of the cord or seminal vesicles.

The differential diagnosis between acute gonorrhœal epididymitis and acute tubercular epididymitis in the absence of other tubercular lesions must be held in abeyance until the tubercular process develops with characteristic features. The finding of the gonococcus does not necessarily exclude tubercle.

Prognosis.—It has been already stated that tubercular nodules may become encapsulated and absorbed, leaving a mass of fibrous tissue to mark their position. This does not necessarily indicate that a definite cure has been accomplished, since under favoring circumstances the tubercular foci may again become active and with greatly increased virulence. When the infection is located only in the epididymis or testis, spontaneous cure may result from this process of encapsulation.

The course of the case will be unfavorable in direct ratio to (1) the rapidity of development; (2) the extent of involvement of the gland; (3) the tendency to become bilateral; (4) the association with diffuse uro-genital tuberculosis.

In any event it cannot be too strongly emphasized that, as in all other forms of surgical tuberculosis, the prognosis is extremely grave if the patient is necessarily intrusted to the *vis medicatrix naturæ.*

When the tubercular process is lodged solely in the epididymis or the testicle and is subjected to prompt surgical treatment, the prognosis is extremely favorable. When the affection is bilateral, involving the cord, seminal vesicles, and prostate, surgical intervention promises little success; the main dependence must be placed on constitutional hygienic treatment.

Treatment.—1. *Palliative Treatment.*—When a patient suffering from tubercular epididymo-orchitis will not submit to operation, or when the disease is so wide-spread that its complete removal is impossible, hygienic measures adapted to tubercular patients generally are indicated. The most efficient of these is probably out-door life in a suitable climate. The drugs most likely to be of use in this class of cases are cod-liver oil, syrup of ferric iodide, compound syrup of hypophosphites, preparations of cinchona and kola, whiskey, and beef peptonoids. The testicles should be protected and supported by the pressure suspensory bandage described in the treatment of gonorrhœal epididymis or by a well-fitting jock-strap.

2. *Radical treatment*, when the disease is strictly localized,—*i.e.*, when it appears in the form of small, separate nodules or foci of caseation,—may consist in incision, followed by vigorous scraping of the infected tissues and packing with iodoform gauze.

Excision of the epididymis or a portion of the testis is indicated when there is reason to believe that a considerable part of the gland may be safely left. An incision is made on the outer posterior scrotal surface and the epididymis is cut away from below upward, the blood-vessels lying along its inner border being spared. If the vas be healthy, the divided end is split for one centimetre, and this broadened open end is so secured over the rete testis that the continuity of the seminal passage is secured.

Injections of ten per cent. emulsion of iodoform in glycerin have given excellent results, and are particularly indicated when the disease is bilateral and cannot be eradicated by erosion or excision of the epididymis. From five to fifteen drops of this mixture should be employed for one treatment, and should be driven directly into the infiltrated mass, the needle being introduced at several points and two or three drops being deposited at each point. This treatment is conducted under antiseptic precautions. The injections are repeated every third or fourth day, depending upon the violence of the reaction.

There can be no question as to the permanence of many cures reported from the injection treatment, though as a result the epididymis becomes hopelessly obliterated.

Castration is the final operation applicable to advanced cases.

This treatment is indicated when the tuberculous involvement is too extensive to be removed by erosion as a partial operation, and when other tuberculous lesions are either absent or but moderate in extent.

When castration is performed, not only the testicle but all infiltrated skin and cellular tissue should be removed. The cord should be divided high up, and the vas should be followed beyond the limits of nodulation or infiltration, even into the pelvis, if this is required by the extent of the disease. After separation and ligation of the vessels, by making traction upon the vas deferens, which would come out in its entire length without risk to the patient, the operation may be completed. When the vas is infiltrated through its entire length, the incision for castration should be extended from the scrotum upward parallel to Poupart's ligament and down to the peritoneum, which should be separated from the lateral walls of the bladder by the finger, using the vas deferens as a guide, until the top of the seminal vesicle is reached. The vas is divided at this point and extracted. Roux suggests that when the ampulla of the vas, the prostate, and the seminal vesicles are involved, a semilunar incision should be made in front of the anus, the rectum separated from the prostate, a transverse incision made in the fascia covering the seminal vesicles and vasa, and the diseased structures peeled off from the bladder and removed. Of eleven cases thus treated by Von Bünger eight were free from recurrence after more than five years; one died of miliary tuberculosis.

Haas has shown that double castration in cases of tuberculosis of the testicle is followed in over fifty per cent. of cases by radical cure, and does not cause mental or nervous disturbances. Subsequent to unilateral castration the disease appeared in the remaining testicle in one-fourth of the cases. Following any operation the hygienic and dietetic treatment appropriate to tuberculosis should be continued for a long time.

Syphilis of the testicle and epididymis has already been described. Scirrhous and gummatous orchitis are frequent manifestations of constitutional disease, and are most likely to develop during the period of life when sexual activity is greatest. They may begin insidiously or with symptoms of acute inflammation, and may form nodules at the head of the epididymis, or may attack the testicle alone. The tumor formed by gummata is nearly always painless, except from its weight. This infiltration may soften and break down, forming fistulæ or fungus, or may lead to atrophy of the gland.

The diagnosis of syphilitic epididymitis from the tubercular affection is based on the density and sharper demarcation of the syphilitic nodules, and particularly on the history of the case and the effect of constitutional treatment. Acute syphilitic orchitis is characterized by the primary development of the affection in the testis, by the history of syphilis, by the absence of other sufficient cause for the disease, and by the effect of constitutional treatment. Gummatous orchitis differs from tubercular disease in forming a larger, denser tumor before softening occurs, one that commonly involves the entire testis, forming on its surface ridges or nodules and never reaching the size of a man's fist before breaking down. It is commonly masked in part by an associated hydrocele and is often bilateral. Gummatous fistulæ lead down to the testicle and open on the anterior surface of the scrotum, differing in both these respects from the tubercular fistulæ. The diagnosis between syphilitic and tubercular orchitis may be impossible from inspection and palpation. The distinction of syphilitic sarcocele from hæmatoma is made solely on the history of the development of the tumor or upon the result of aspiration.

TUMORS OF THE TESTICLE.

An elaborate classification of tumors of the testis, such as is given by Monod and Terrillon, is of little practical value. For clinical purposes tumors may be classed as malignant and benign. The tumors which are usually malignant include carcinomata, sarcomata, cystomata, lymphadenomata (lymphosarcomata), enchondromata, myxomata, and mixed tumors. Tumors usually benign are fibromata, osteomata, and myomata.

Carcinoma.—Carcinoma is the most frequent tumor of the testis. Langhans has contributed an elaborate histology of the affection, based on a study of thirty cases. The tumor may be of a soft (medullary) or hard (scirrhous) type. Medullary carcinoma is the more frequent form. The etiology is obscure, but is often traceable to trauma; the disease exhibits a special predilection for undescended testes, probably because these are so frequently subjected to repeated slight injury. Gonorrhœal epididymitis, syphilis, and other inflammations may act as predisposing causes. Paget states that cancer attacks the testicle in two and eight-tenths per cent. of all cases of malignant disease. The disease usually develops in the adult; exceptionally it attacks the testes of children.

Kocher teaches that the tumor usually begins in the centre of the testis, though it may originate in any part of this gland or in the epididymis, or may invade both structures simultaneously; ultimately it extends along the cord. Exceptionally, malignant infiltration of this structure may develop early, in the course of the lymphatic vessels. The scirrhous tumors are much smaller than the encephaloid, rarely reaching the size of a fist. In both forms of the affection there is rapid invasion of the post-peritoneal lymphatic glands, with further upward extension to those of the mediastinum or even of the neck.

Kocher finds that more than one-half the cases of cancer of the testes develop between the thirtieth and the fortieth year. Of thirty-seven cases, twenty-eight developed between the twenty-fifth and the forty-fifth year. The soft tumor usually grows rapidly, sometimes attaining the dimensions of a child's head. The growth in the scirrhous form is much slower.

The tumor usually corresponds to the form of the testis until it has thinned or perforated the albuginea, when it becomes irregular and nodulated. The tunica vaginalis is partly obliterated by adhesions; the portions not thus closed are filled with blood-stained serum. As the tumor proliferates it may involve and destroy the skin, forming a cauliflower-like mass of bleeding granulations (fungus hæmatodes).

The consistence of the tumor varies greatly: often nodulations alternating with areas of softening are felt through its substance; it may exhibit parenchymatous hemorrhages or various degenerations, as mucoid or colloid.

In the early stages the epididymis may often be felt entirely uninvolved. Later it becomes infiltrated and indistinguishable from the mass of the tumor. Hydrocele or hæmatocele may complicate the affection from the beginning and conceal the enlargement.

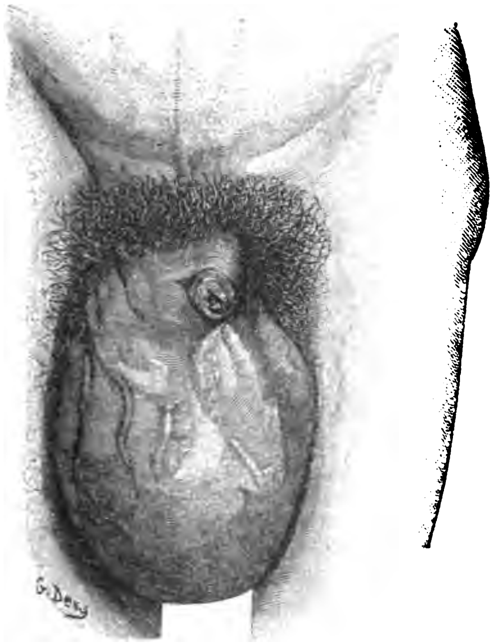
The swelling often develops without pain, but rarely when the growth is very rapid; reflex pains are usually indicative of involvement of the cord and glands. Testicular sensation is lost early. The first symptom of lymphatic involvement may be pains referred to the inguinal region or the back, or along the course of the sciatic nerve, or radiating down the thighs. The enlarged retroperitoneal glands can usually be felt on abdominal palpation; by pressure upon the veins they may cause œdema of the legs. The inguinal glands are not enlarged until the scrotum becomes involved. Cachexia becomes marked when secondary deposits develop.

Kocher notes that in malignant tumors of the testicle the vessels of the cord become extremely large, thus differing from the swelling caused by simple hydrocele. Moreover, the scrotal veins are nearly always dilated.

Diagnosis.—The early detection of carcinoma of the testis is of cardinal importance, since intervention is hopeless unless undertaken before involvement of the lymphatic glands. An apparently causeless induration of the testicle followed by rapid and progressive increase in size with little alteration of form is highly indicative of malignant growth, especially if accompanied by marked dilatation of the blood-vessels of the cord and scrotum. When the tumor is masked by hydrocele, the latter should be treated by open incision, thus allowing the testis to be inspected and palpated.

Malignant growth following traumatism may be distinguished from traumatic orchitis only by the progressive increase in the size of the testis. When the cancer is thoroughly developed it is not likely to be confounded with any other affection. (Fig. 200.) The large tumor, the infiltration of the cord, the involvement of lymphatic glands, the discoloration of the scrotum, the enlargement of the blood-vessels, and finally the cachexia, are all characteristic. Gumma of the testicle never grows larger than the size of the fist, and does not enlarge the glands. Moreover, it is sometimes bilateral, and yields to specific treatment. The distinction from sarcoma and cystoma cannot be made.

FIG. 200.



Cancer of the right testicle. (Monod and Terrillon.)

Hæmatocele may be mistaken for malignant disease. There should, however, be a history either of trauma with a growth developing within a few hours, or of an old hydrocele into which hemorrhage may have occurred. In hæmatocele pain is an early symptom, and the swelling increases intermittently and not by steady growth; it is less bossed and irregular than in malignant disease; testicular sensation is not so completely lost. Tapping may establish a diagnosis, though it must be remembered that there is often blood effusion into the tunica vaginalis in cases of malignant disease.

An old hydrocele with thickened sac, containing fibro-cartilaginous material, and exhibiting a hard and uneven surface, may resemble the hard form of the malignant disease. When it is impossible to distinguish between these two affections, an early incision, followed by an operation appropriate to the condition found, is advisable.

Prognosis.—The prognosis of carcinoma of the testicle is bad, particularly when the retroperitoneal glands are involved. Paget states that the duration of life is on an average twenty-three months, patients living about six months after operation, since, as a rule, they do not consent to surgical intervention until after they have suffered from the disease for one and a half years. Death is nearly always due to metastasis. The scirrhous form of the disease runs a slow course: Nepveu reports one case which survived fifteen years.

A few cases of radical cure have been recorded. Winiwarter, of twelve cases, found one living two years and seven months after operation. Robin and Volkmann report four cases as living three years. Kocher publishes the records of six cases; the diagnosis was thoroughly confirmed by microscopic examination; two were well one year after operation, one one and a half years, one four and a half years, one eight and a half years, one ten and a half years; in only one instance was the operation performed early.

Treatment.—Early castration with removal of as much of the cord as possible is the only treatment to be considered. Any enlarged glands which can be felt should be removed at the same time if this is practicable. These glands, when they attain considerable size, are densely adherent, and their removal is extremely difficult. They are probably best approached through the peritoneal cavity.

Sarcoma.—This may appear as a soft, round-celled tumor or as a comparatively hard, spindle-celled growth. In the latter case the sarcoma is often mixed with mucoid, muscular, or cartilaginous tissues (mixed tumor). The distinction between sarcoma and carcinoma can be made only by the microscope; clinically they develop in the same way, and they are equally malignant. The sarcomata are more likely to have associated with them different abnormal tissues;

the presence of these may make a distinction from cancer possible, the latter being usually a uniform growth. Sarcoma is sometimes bilateral. A spindle-celled sarcoma is somewhat less malignant than carcinoma.

The symptoms and treatment are the same as for carcinoma.

Cystoma.—Morris states that cystic disease of the testicle may become manifest in the form of a number of minute cysts interspersed with other cysts of medium size, in that of firm, dense, fibrous tissue in which are numerous cysts of varying size, or in that of small, unequally distributed cysts placed in a stroma of round-celled sarcomatous tissue.

The contents of cysts may be clear, mucoid, or like coffee-grounds. Sometimes they contain intracystic, cauliflower-like growths, and the stroma in which they are placed often exhibits areas of cartilaginous and sarcomatous degeneration. The disease usually begins in the mediastinum, pushing the substance of the testicle upward and forward.

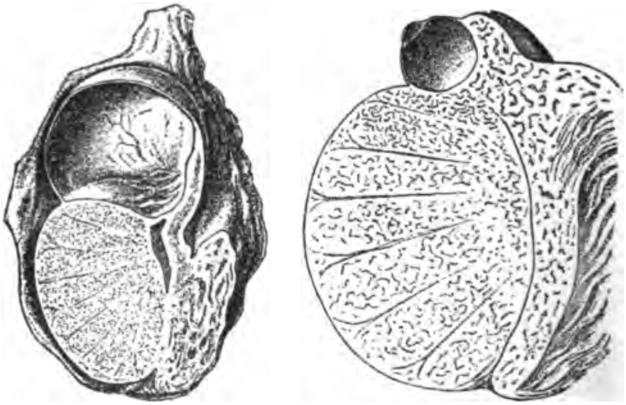
The comparatively benign form of the disease may last for many years, forming a smooth regular tumor of moderate size rarely larger than the fist, which may exhibit areas of fluctuation or may seem to be uniformly semi-solid. The sarcomatous cysts grow rapidly, attain large size, and become bosselated.

Cystic disease develops without pain, and does not involve the cord. It is probable that the fibrocystomata may be benign, but they so commonly give rise to metastasis that they are properly classed as malignant. The treatment is castration.

Encysted Hydrocele of the Epididymis and Testis.—These affections are in reality cysts, and are discussed elsewhere. (See below.) In this affection the fluid is contained in distinct cysts, which may or may not project into the cavity of the vaginal tunic; this tunic, or at least its parietal layer, does not form the walls of the cysts. These cysts may originate in the epididymis, in fœtal structures lying near by, or in the testicle. (Fig. 201.) They may contain a milky fluid, which under the microscope is found to be filled with spermatozoa (this is particularly true of the larger cysts), or their contents may be perfectly translucent, but differing markedly from hydrocele in composition, since they contain little or no albumen.

Cysts of the Epididymis.—These cysts may be small or large; the small cysts are usually multiple, and, according to Gosselin, develop in the majority of testes after middle life. They may be very minute or as large as a pea, and are sometimes pedunculated. They are easily shelled out from the surrounding tissue. Exceptionally they contain spermatozoa. They are placed both on the surface and in the parenchyma of the epididymis. They may develop from the remnants of fœtal structure; more probably they are involution cysts, originating in the tissue of the epididymis, but becoming subserous.

FIG. 201.



Intravaginal spermatocele. (Hochenegg.)

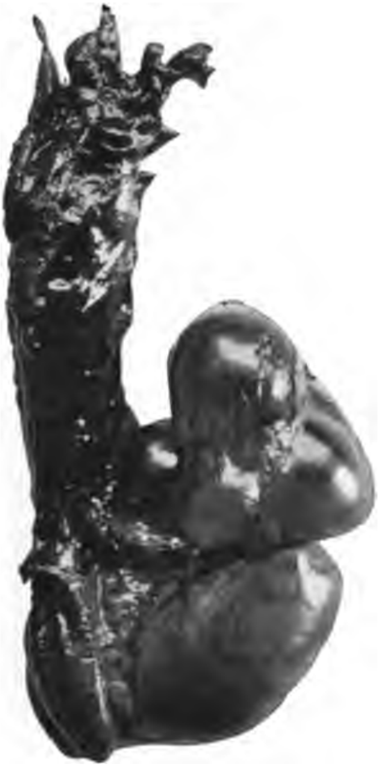
The large cysts are parenchymatous, arising beneath the outer covering of the epididymis and close to its upper part, or between it and the upper part of the testicle. (Fig. 202.) They lie outside of the visceral layer of the vaginal tunic, pushing this upward as they become distended, and are in close contact with the seminal ducts. They are usually single, but may be multiple or multilocular. Commonly the fluid is milky from the spermatozoa which it contains, though it may be limpid. These cysts may arise either from retention cysts or from the development of the fœtal remains. Spermatozoa may find their entrance into them through minute openings, difficult to recognize at any time, and capable of closing long before the cyst is examined. They rarely attain great dimensions, containing on an average not more than two or three ounces of fluid. Exceptionally they may form large tumors. (Fig. 203.) They are not confined to old age, developing at any time after full sexual maturity.

Morris states that the cyst may originate as a retention cyst due to dilatation of a seminal tube, owing to some obstruction in the vas deferens or other part of the excretory passages (Liston, Luschka, and others); or as a new formation in the connective tissue between the tubes of the epididymis subsequent upon the rupture of a seminal tubule and the escape of some drops of seminal fluid. The opening in the duct may afterwards cicatrize, so that there need not persist a communication between the duct and the new-formed cyst.

The cyst may be formed originally in the connective tissue, and by gradually enlarging may cause subsequently the rupture of a seminal tubule, and thus the entrance into the cyst of spermatozoa. (Curling.) The cysts may arise from the distention of certain fœtal relics which exist in the neighborhood of the epididymis, especially near the globus major.

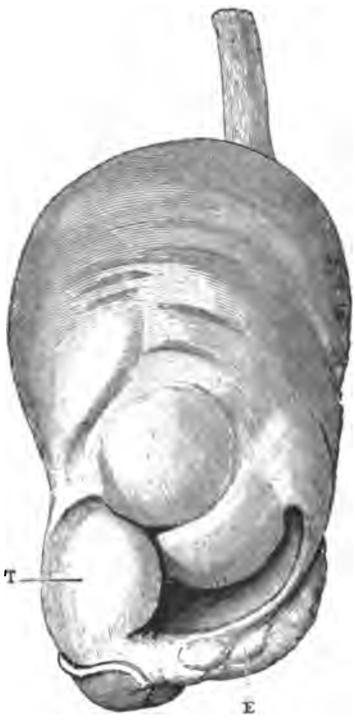
The fœtal structures from which cysts of the epididymis originate are—(1) The paradidymis, or organ of Giraldès, a minute body, the remnant of the mesonephros or glandular portion of the Wolffian body. This is situated in front of the lower part of the vas and above the head of the epididymis and behind the upper part of the tunica vaginalis. Cysts having this origin are situated above the testis and epididymis, and extend sometimes a little way along the cord. They correspond to paroöphoritic cysts in the female. (2) The ducts of

Fig. 202.



Encysted hydrocele (large cysts).

Fig. 203.



Multilocular cyst of the epididymis. *T*, testicle; *E*, epididymis displaced by the cyst. (Monod and Terrillon.)

Kobelt, which are remnants of the tubules of the Wolffian body, situated in the globus major. (3) The vestiges of the duct of Müller, part of which is represented by the hydatid of Morgagni, can sometimes be traced from the globus major down to the globus minor, along the body of the epididymis in the digital pouch. Cysts derived from these sources are situated between the epididymis and testis, most frequently between the globus major and the upper end of the testis. Those derived from the vasa efferentia and other remnants of the Wolffian tubules are homologous with parovarian cysts in the female. (4) The vas aberrans of Haller, which is a diverticulum of, or a convoluted cæcal tube opening into, the vas deferens close to the lower end of the epididymis; this also is a part of the remains of one of the tubes of the Wolffian body still in connection with the representative of the excretory duct of that body,—namely, the vas deferens.

Cysts of the Testis.—These grow in front of the gland between the tunica albuginea of the testis and the testicular portion of the tunica vaginalis. They are usually of small size, and from intracystic tension feel like a hard body.

Symptoms of cysts of the epididymis and testis are slow in developing, though exceptionally, from traumatic rupture of a cyst into the cavity of the vaginal tunic, there may be swelling and pain characteristic of acute hydrocele. Small cysts, particularly those of the epididymis, are recognized with difficulty even after careful palpation. As they increase in size they form distinct fluctuating tumors, which, if the fluid is clear, will give the test of transmitted light. These cysts have often been mistaken for supernumerary testicles, or, because of tension and consequent hardness, for tubercular infiltration of the epididymis. They seldom reach large size.

Diagnosis is founded upon translucency when the fluid contained in the cyst is limpid. Thrill, fluctuation, want of density and resistance, and slowness in development distinguish these cysts from ordinary sarcoceles. In shape they are globular when small, but if large and multilocular the shape varies greatly. By transmitted light the testicle is usually seen lying below and in front of the tumor, although it may be to one or the other side, more frequently the inner. On palpation it is often possible to determine that the enlargement is absolutely limited to the upper portion of the testis and epididymis, and has a tendency to extend upward along the cord, the testis proper being perfectly normal and the tunica vaginalis containing no fluid. At times exploratory puncture with a hypodermic needle will be necessary before a diagnosis can be established. The fluid obtained will be found swarming with spermatozoa.

Treatment.—These cysts grow so slowly and cause so few symptoms that intervention is often not necessary. Evacuation by means of an aspirator or a small trocar and canula may be followed by cure. If this fails, iodine may be injected, as described in the treatment of hydrocele, or the scrotum may be opened and the cyst dissected out. The operation of excision is particularly indicated when the cysts are multiple or multilocular. When complete excision is impossible without extensively injuring the structure of the testicle or epididymis, the cyst-wall should be removed as thoroughly as possible, and the remaining portion should be cauterized with carbolic acid.

Enchondroma originates in the interstitial connective tissue of the rete testis; it is commonly found between the thirtieth and the fortieth year of life. It is rare in children and unknown in old age. The development of the tumor is as symptomless as that of carcinoma. There forms a hard, gradually growing mass, which causes inconvenience only by its weight. After growing slowly for some time there may be a sudden increase in the rate of development, often characterized by the appearance of soft, fluctuating spots in the dense tumor. Ultimately enchondromata undergo metastasis.

The enchondromata may be simple or mixed.

SIMPLE ENCHONDROMA is extremely rare. A small, dense tumor appears not larger than a walnut, and persists, without increase in size, for many months or even for several years. The epididymis and cord are not affected until the late stage of the disease. After a long period of inactivity there may be rather rapid growth, in which case the enlargement becomes irregularly lobulated and is extremely dense.

MIXED ENCHONDROMA contains between the cartilaginous masses sarcomatous tissue. It is more rapid in its course, grows to a larger size, more commonly exhibits areas of softening, and invades the cord.

Diagnosis.—The diagnosis is founded upon the density and nodulation of the growth, its comparatively slow development, the absence of pain, and the ultimate dissemination. Soft or fluctuating areas suggest a mixed tumor and therefore the more malignant form of enchondroma, though tumors made up entirely of cartilage give metastasis.

Treatment.—Early castration is the only treatment to be considered.

Lymphadenoma is a rare affection, which can be positively distinguished from other malignant sarcoceles only by microscopic examination. It does not reach the size of sarcoma or carcinoma, is not prone to ulcerate or to cause hydrocele, does not infiltrate the epididymis, and causes a symmetrical enlargement of the gland. It is often bilateral, and sometimes is associated with lymphadenoma in other portions of the body. It develops in the testes of young men. (Fig. 204.)

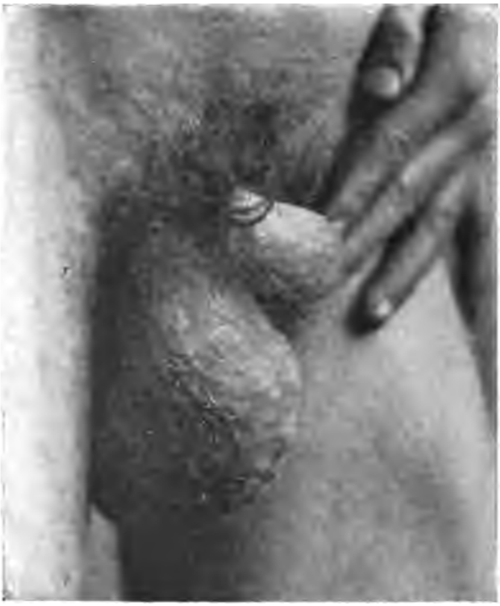
Fibroma of the testicle is extremely rare. It develops as a hard, painless tumor, springing apparently from the proper tunic of the testicle, and producing pressure atrophy of the gland. Neither the cord nor the epididymis is involved, and hydrocele does not develop. It occurs in early manhood, and may be bilateral.

The diagnosis is made from the hardness of the tumor, the absence of involvement of the cord and the epididymis, the slowness of development, and the preservation of testicular sensation.

The treatment is excision.

Dermoid Cysts.—Dermoid cysts, or teratomata, are congenital growths, containing hair, skin, sebaceous material, bone, teeth, or portions of other organs. The tumor may be found in the testis or entirely outside of it. It is usually adherent to it, and placed between the testis and the epididymis, or in front of the testicle. These tumors may remain stationary, may grow rapidly, or may suppurate.

Fig. 204.



Lymphadenoma of the testicle (bilateral).

Diagnosis can be made positively only by an examination of the contents of the cyst. The fact that the tumor is congenital suggests its nature. It may remain quiescent until puberty or between the twentieth and the thirtieth year. Commonly it develops in the first few months of life.

Verneuil states that there is often a period of stagnation, during which the tumor grows in proportion to the general development. This is followed by an inflammatory period, during which there is rapid growth. This may not occur for many years. When the tumor grows slowly it may reach large size without causing any symptoms aside from its weight. The size of the tumor may be enormous. It may be as hard as an enchondroma or soft and fluctuating.

Myxoma, osteoma, and **myoma** are surgical rarities which need no detailed description. Indeed, these tumors have been so seldom observed that their symptomatology and clinical course cannot be formulated. They are mainly important because they obscure the diagnosis of malignant growth. It is impossible, for instance, to distinguish osteoma from enchondroma except by the test of time.

CASTRATION.

This operation, indicated when the diagnosis of malignant disease is confirmed, would probably be attended with a large percentage of radical cures were it undertaken in the early stages of infiltration. During this period it is impossible to formulate the diagnosis.

When tubercle or syphilis, or sufficient cause for acute or chronic inflammation of the testis, can be excluded, we believe enlargement of this gland should be subjected to exploratory incision, followed by immediate castration if there is reason to suspect malignant growth, or by microscopic examination of excised tissue in case palpation and direct inspection lead the surgeon to believe that the induration is probably not malignant. The exploratory incision is in itself harmless, and even when the diagnosis is apparently well assured should precede castration. We have seen a hæmatocele with walls two inches thick, and containing cartilaginous nodules, develop absolutely according to the type of malignant growth, with the exception of glandular involvement. Preliminary incision would in such a case be the means of saving a comparatively healthy testicle. If on exploratory excision either a solid tumor or cystic degeneration is found, syphilis and tuberculosis having been excluded, the chances are largely in favor of its malignancy.

Castration is attended with little danger. Kocher reports but one death in twenty-three cases operated on. This death was due to pyæmia. The shock of which so much has been written we have never seen, even when removing comparatively healthy testicles. It is still less likely to occur when the testicular substance has been destroyed by infiltration.

Preliminary cleansing of the operative region should be repeated several times, at intervals of some hours, and immediately before operation the penis should be tightly bandaged in sterile gauze, since it is a frequent source of infection in operations about the genitalia.

The incision varies in accordance with the conditions. When the tumor is small and non-adherent and the cord is not involved, an opening over the external abdominal ring large enough to allow the tumor to be pulled out suffices. If the growth is large, adherent, and extending up the cord, the incision should be so planned that all the adherent skin will be removed, and should run parallel with Poupart's ligament, half an inch above it, to the position of the internal ring. The incision should be made layer by layer, as this enables the operator to judge of the amount of integument involved and to decide on the extent of interference required. The incision should go wide of diseased tissue, the vaginal tunic and the greater part of the scrotal tissues of the affected side being taken with the growth.

Bleeding is checked by hæmostatic forceps; the testicle is freed from its surroundings and drawn well down, while a finger passed up along the cord determines its position and acts as a director to open the inguinal canal as far as may be necessary.

The cord is isolated above the point of perceptible involvement, drawn well down, transfixed with a gut ligature, tied in two portions, cut across below the seat of ligation, and the lumen of the vas cauterized with pure carbolic acid.

If the vascular constituents of the cord are ligated separately, three arteries—the cremasteric, the spermatic, and the deferential—must be tied. The deferential artery is found close to the vas, and with it are a few veins; the cremasteric lies to the outer side of the cord, near its surface; the spermatic is in front of the cord, surrounded by the anterior group of veins, and can scarcely be distinguished from them. Each artery should have a separate ligature, but the two sets of veins may be tied *en masse;* the divided cord should be secured with artery forceps until the end of the operation. The bleeding from the scrotal tissues is controlled by forcipressure or ligatures, and redundant portions of the scrotum, particularly those which may be infiltrated, are removed. The edges of the wound are then carefully approximated, care being taken to prevent inversion by the dartos. The sutures should be of silk, and the last one may secure a drainage-tube in the lower angle of the wound if the case has been an infected one. Otherwise drainage is unnecessary.

An antiseptic dressing is applied and held in place by the crossed of the perineum.

The patient may sometimes complain of retention of urine, lasting from twenty-four to thirty-six hours. This is best relieved by enemata of hot saline solution. Should this fail, the catheter may be used. The stitches are removed on the fifth to the seventh day.

When the cord is extensively involved, the incision should be extended up along Poupart's ligament, as already described. It is deepened to the peritoneum, which is stripped up, allowing access to the glands of the pelvis. When the lymphatic involvement extends upward beyond reach it may be attacked through a transperitoneal opening. The glands into which the vessels of the cord pass completely surround the aorta. There is, moreover, one lying upon the external iliac artery which probably will be involved.

HYDROCELE.

Hydrocele is a condition in which there is an abnormal amount of fluid about the testis or the cord, limited by the tunica vaginalis. Hydrocele, without further qualifying words, as "encysted" or "of the cord," indicates a serous effusion between the two layers of the tunica vaginalis testis.

Prolongations of peritoneum, called the vaginal processes, precede the testicles in their descent into the scrotum, thus forming a pouch, into which the testicle with its epididymis is invaginated. The funicular portion of this pouch usually becomes obliterated from the internal abdominal ring to a point just above the testis, leaving a serous sac enveloping this organ, in which is normally found just enough fluid to allow its surfaces to glide smoothly over each other.

The invagination of the testicle into the peritoneal pouch necessarily forms a parietal and a visceral portion. The parietal portion forms a loose investment, extending above and below the testis, and connected by cellular tissue to the surrounding structures of the scrotum. The visceral portion invests the testis and the epididymis, connecting these structures, and forming a fossa or pouch between them (digital fossa). At the posterior portion of the gland it becomes continuous with the parietal layer. The tail of the epididymis is not included in the double serous envelope, since the reflection of the visceral layer is upon the front and sides of the scrotal ligament of the testicle, a fibro-muscular band passing from the lower posterior portion of the testis and the tail of the epididymis to the dartos.

ACUTE HYDROCELE.

This affection, an acute vaginalitis, is usually due to extension of acute inflammation from the epididymis. It is also secondary to orchitis, and may be caused by traumatism or irritating injections.

It is probable that in every case of epididymitis there is some extension of inflammation to the tunica vaginalis, and that the acute effusions which complicate infectious diseases or catheter urethritis are secondary to epididymitis or orchitis.

The pathological changes in the tunica vaginalis are essentially the same as those occurring in acute inflammations of serous membranes in other parts of the body.

The effusion may be serous or fibrinous. Serous effusion, though common, is not often examined clinically, since it is slight, transitory, and indicative of a mild inflammation. Plastic effusion does not differ from ordinary inflammatory lymph. Suppuration is extremely rare.

Symptoms.—The symptoms of acute hydrocele are masked by those of the primary disease. Thus, in gonorrhœal epididymitis the usually moderate amount of effusion into the vaginal tunic is obscured by the œdematous swelling of the entire scrotum. If effusion is abundant it will form a tense, rounded or pyriform, fluctuating tumor which is translucent and which feels like a greatly enlarged testicle.

The pain attending acute hydrocele is sometimes extremely severe, corresponding in type precisely to that of gonorrhœal epididymitis. This pain is doubtless due to tension, since puncture affords almost immediate relief. In addition to pain and swelling there are present heat, redness, and scrotal œdema. The general constitutional symptoms are, as a rule, slight.

Diagnosis.—The most important single diagnostic sign is translucency. This symptom may be best elicited by the employment of a tube about half an inch in diameter; an ordinary stethoscope will answer. One end of this tube is applied to the scrotum, the examiner looking through the other end while a bright light is held close to the opposite side of the tumor. The method of examining the scrotum by making the overlying tissues tense by pressure is not applicable to an acute hydrocele, because of the pain this manipulation excites. Another method of eliciting translucency is to place against the scrotum the open end of a shallow cup in which is an electric light. Examinations for transmitted light must be conducted in a dark room. In case the fluid is mixed with blood, this test will be inconclusive. The aspirating needle will then prove serviceable, though before employing this instrument the surgeon should be sure that he is not dealing with strangulated hernia. On the subsidence of acute inflammation the diagnosis can be made without difficulty by determining the presence of fluid. This test is made by seizing the scrotum in the left hand and making the skin over the swelling moderately tense. Then, by sudden pressure with the finger of the right hand, the sensation of liquid being pressed aside will be noted before the comparatively firm resistance of the testicle is felt; or by the alternate pressure of the two hands fluctuation will be detected. When inflammation has still further subsided, the presence or absence of fibrinous deposits may be determined by seizing the testicle in front and pressing it backward from between the thumb and fingers. Ordinarily it readily slips back, leaving in the grasp the scrotal tissue and the external layer of the vaginal tunic. If the parietal and visceral layers of the vaginal tunic are adherent, the testicle will not slip back from the grasp in this way, or, if it does, will leave a thickened mass between the thumb and fingers.

Examination on the subsidence of inflammation will generally show thickening and induration of the epididymis.

Double hydrocele is usually accompanied by sterility, another proof of the almost invariable association of this affection with epididymitis.

Prognosis.—Acute hydrocele may undergo resolution; the plastic deposit may organize partially or completely, obliterating the cavity of the tunica vaginalis; the inflammation may become chronic, constituting the ordinary form of hydrocele, and in this case organization of the fibrinous tissue often divides the general cavity into secondary ones, distinctly separated from one another; or, finally, suppuration may take place.

Treatment.—Acute hydrocele is treated in accordance with general surgical principles: rest in bed, elevation of the part, the employment of evaporating lotions, such as equal parts of lead water and alcohol, or a counterirritant in the form of twenty per cent. guaiacol ointment are useful. The bowels should be purged with salines, and the diet carefully regulated. Pelvic congestion must be avoided. Later, pressure by the suspensory bandage, with the application of mild absorbent ointments, are indicated. The best of these is the official mercury and belladonna ointment of the U.S.P. If the pain becomes unbearable, it may be relieved at once by puncture, as in the case of gonorrhœal epididymitis.

If the effusion is not absorbed in six weeks, treatment appropriate to chronic hydrocele is undertaken.

CHRONIC HYDROCELE.

Jacobson thus classifies chronic hydrocele:

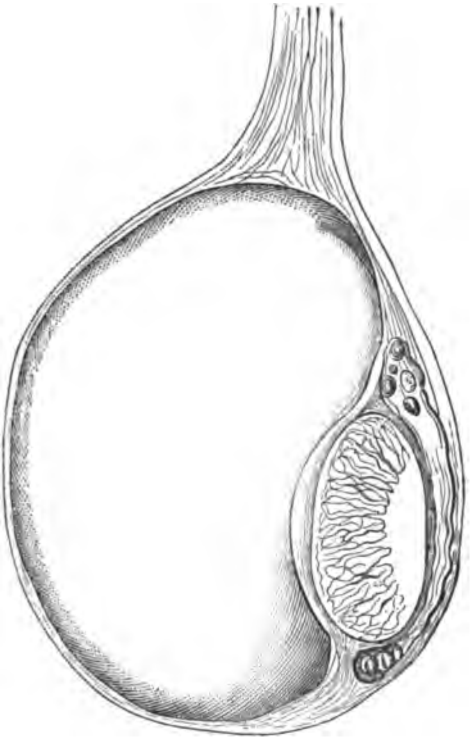
- HYDROCELE.
  - I. Of the testis.
    - (α) *Hydrocele of Tunica Vaginalis.* — The fluid is in a sac connected with that of the tunica vaginalis.
      - 1. *Ordinary Hydrocele.*—The fluid distends the closed sac of the tunica vaginalis.
      - 2. *Congenital Hydrocele.*—A communication exists between the cavity of the tunica vaginalis and that of the peritoneum.
      - 3. *Infantile Hydrocele.*—The tunica vaginalis and the funicular process are distended with fluid, but these are shut off from the peritoneal cavity by an obliteration placed usually at the external ring.
      - 4. *Inguinal Hydrocele.*—Hydrocele in relation with a retained testis.
    - (β) *Encysted Hydrocele.*—The fluid is in a sac distinct from that of the tunica vaginalis.
      - 1. *Encysted Hydrocele of the Epididymis.*—The fluid is encysted in the neighborhood of the epididymis.
      - 2. *Encysted Hydrocele of the Testis.*—The fluid is encysted between the tunica albuginea and the inner surface of the tunica vaginalis.
- HYDROCELE.
  - II. Of the cord.
    - (α) *Diffused.*—The fluid forms a serous collection of the nature of œdema in the cellular tissue of the cord.
    - (β) *Encysted.*—The fluid is contained in a distinct sac originating usually (1) in some unobliterated part of the processus funiculo-vaginalis; (2) in a cyst formed independently of this process,—*e.g.*, by dilatation of persistent tubules of the organ of Giraldès.
  - III. Complications of hydrocele.
    - (α) *With other Cœxisting Hydroceles.*—*E.g.*, (1) hydrocele of the tunica vaginalis with encysted hydrocele of the testis; (2) hydrocele of the tunica vaginalis with encysted hydrocele of the cord; (3) hydrocele of the tunica vaginalis with diffused hydrocele of the cord.
    - (β) *With Hernia.*—*E.g.*, (1) hydrocele of the tunica vaginalis with inguinal hernia; (2) hydrocele of the cord with inguinal hernia.
  - IV. Hydrocele of the sac of a hernia.

Hydrocele of the Tunica Vaginalis Testis.—(Fig. 205.) This, the ordinary form of hydrocele, is in the majority of cases secondary to pathological conditions of the epididymis, testicle, or cord. It is particularly associated with disease of the epididymis.

Loose cartilaginous bodies are sometimes, but rarely, found within the sac, and may by their continued irritation give rise to an abnormal secretion of fluid. Hydrocele may be due to passive exudation caused by an obstruction to the return of circulation. This exudation may be caused by an ill-fitting truss, by the presence of filariæ, or by hepatic or renal disease. The frequent occurrence of hydrocele in warm climates and in persons suffering from malaria is due to associated hepatic enlargements. In general dropsy the scrotal tissues may be œdematous, but fluid in the tunica vaginalis is seldom or never found.

A certain number of cases seem to be idiopathic,—*i.e.*, there is no discoverable preceding inflammation of the scrotal contents.

FIG. 205.



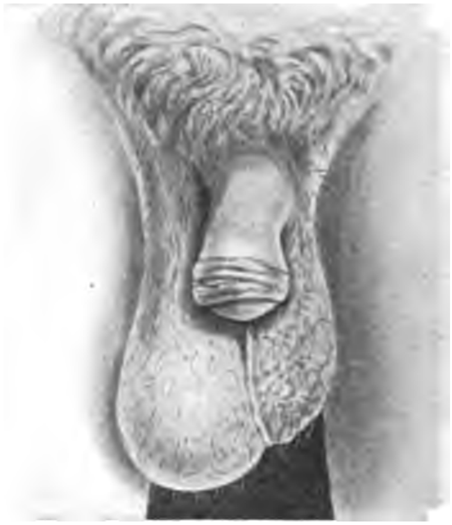
Vertical section of hydrocele. (Kocher.)

Chronic hydrocele may begin in the acute form, the effusion failing to be absorbed, and gradually increasing in quantity, or the onset may be insidious, the patient first detecting the condition by the increase in the size of the scrotum.

Jacobson holds that "in the great majority of cases the effusion of fluid commences passively, and without any irritation or inflammation to begin with, the causes predisposing to its production being the pendent position, the less vigorous condition of the cremaster and dartos, feebler cardiac circulation, deficiency of tone in the scrotal blood-vessels and lymphatics, together with, perhaps, a tendency to venous congestion from hepatic and renal degeneration. All these conditions, which combine to bring about a passive effusion, are naturally most active in middle life, this being the age when the ordinary hydrocele of the tunica vaginalis is most frequently met with. After a while, as the fluid increases in bulk, it becomes, from exposure to friction, etc., liable to irritation and inflammatory changes, which show themselves both in the fluid and sometimes in the tunica vaginalis itself."

It is evident that from the etiological stand-point hydroceles may be classed as those developing primarily, and those secondary to traumatism, inflammation, or degeneration of the testicle, epididymis, or cord.

Fig. 206.



Hydrocele.

The fluid of chronic hydrocele is clear, yellowish, and much like that found in ascites. The specific gravity is about 1022, the reaction is neutral or slightly alkaline, and the fluid contains fibrin, albumen, and paraglobulin. The quantity of albumen (from four to six per cent.) found in the fluid strongly suggests the inflammatory origin of the affection.

In some cases cholesterin crystals are seen in the contents of a hydrocele, giving it a beautiful shimmering appearance. There is sometimes slight admixture of blood, the coloring-matter of which may be deposited in the form of blackish sediment. Tubercle bacilli have been found.

The average amount of fluid is from four to eight ounces. This produces a tumor of such dimensions that it becomes inconvenient, and the patient seeks surgical help. Some extraordinarily large accumulations have been observed, in one case more than six gallons.

Kocher in 309 cases of hydrocele found that 57 developed in the first twenty years of life, and 76 after the fiftieth year; the remaining 176 were observed between the twentieth and the fiftieth year.

Krönlein states that thirty-nine per cent. of hydroceles are developed in the first year of life, and forty-eight and eight-tenths per cent. in the first five years.

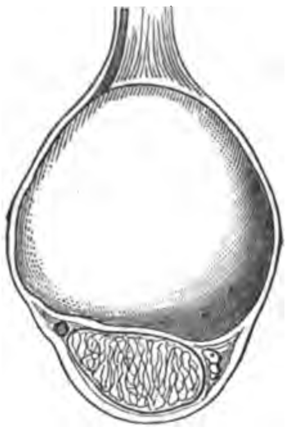
Coley and Satterwhite note that of 2214 cases of hydrocele, 1603 were in children less than fourteen years old. One hundred and three were in the canal of Nuck.

Symptoms.—Chronic hydrocele, unlike the acute affection, is characterized by the absence of symptoms, the patient experiencing no inconvenience aside from the weight and size of the tumor. The rate of the growth varies greatly. It may reach a large size in a few weeks, or may increase so slowly that a tumor of troublesome dimensions is not formed for years.

The tumor is usually smooth, tense, fluctuating, and pyriform, with the base below. It begins at the lower portion of the scrotum and grows upward. The veins of the scrotum and cord are not dilated in proportion to the size of the growth. The cord can usually be felt at the apex of the tumor; testicular pain, when elicited, gives information not only as to the condition of this organ but also as to its position. The skin is smooth, white, and apparently normal. If the tumor is held in one hand and lightly percussed with one finger of the other, a vibrating thrill is felt which is characteristic of fluctuation. When the swelling reaches large dimensions the penis is practically concealed in a fold of the skin. The tumor is dull on percussion, is heavy, and when pushed back between the legs springs forward again to its original position.

Coincidently with the accumulation of fluid there is often chronic thickening of the vaginal tunic; this exceptionally undergoes cartilaginous or calcareous degeneration. Sometimes the visceral and parietal walls of the tunica vaginalis become adherent at points. Under these circumstances palpation may show certain indurated spots or distinct lobules. It is important to know the position of the testicle in hydrocele, since otherwise it may be wounded in operations designed for cure. This gland usually lies in the mid-posterior portion of the tumor. Exceptionally, when there is inversion or when adhesions have formed, the testicle lies directly in front of the tumor and may be readily wounded, or it may lie at its lower pole. (Fig. 207.) The position of the testicle is determined by pressure. This, if suddenly exerted by one or two fingers over various parts of the tumor, will produce the characteristic sickening pain when the testicle is reached. Transmitted light will better show the position of the testicle.

FIG. 207.



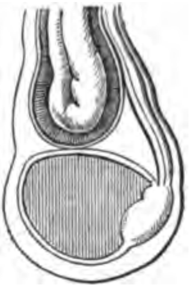
Vertical section of a hydrocele, showing the testicle lying below the cyst (Kocher.)

Diagnosis.—The diagnosis is based upon the development of a tumor in the lower part of the scrotum, its fluctuation, its pyriform shape, its projection forward, its translucency, and the small size of the cord. The light test should be conducted in a dark room, and the skin of the scrotum and the vaginal tunic should be made tense by grasping the tumor from behind with the left hand. The electric light may be used as described under acute hydrocele, or translucency can be elicited by means of an ordinary candle. The surgeon, having placed the patient on his back, makes the tumor tense with the left hand, placing his right hand on the upper convex border, thus shading his eyes from the source of light, which is held close to the scrotum on the side opposite that from which the surgeon is conducting his inspection. This test will fail when the hydrocele contains a large quantity of cholesterin or when the fluid is turbid from blood, fat, or spermatozoa. Omental hernia may be slightly translucent, but the bright red glow so characteristic of ordinary hydrocele is never seen. The final diagnosis is dependent upon aspiration. This should not be practised until every effort has been made to exclude the presence of hernia. When fluctuation, transparency, and testicular sensation cannot be elicited, the diagnosis will depend upon the use of an aspirating needle, or, better than this, an incision, since thus can be made a thorough examination of both the testicle and the epididymis.

The differential diagnosis is to be made from hernias, neoplasms, other varieties of hydrocele, and hæmatocele.

The diagnosis from hernia, unless there exists strangulation, with excessive exudation and without the typical abdominal symptoms, is usually not difficult. In hernia there are impulse upon coughing and percussion resonance; the tumor hangs directly down instead of protruding forward, grows smaller or disappears in the night, is reduced with a "flop," and in its development is first perceptible in the groin, then slowly reaches the scrotum. In none of these respects does it resemble hydrocele. In the ordinary hydrocele palpation shows that the inguinal canal is empty, fluctuation is readily elicited, and translucency is marked. These are all characteristics not found in hernia. When, however, a hydrocele becomes acutely inflamed from injury or other cause, and when the history of its formation is uncertain, diagnosis may be extremely difficult, and must be based mainly upon the absence of abdominal symptoms. Hernia and hydrocele may coexist; in this case the typical symptoms of each pathological condition may be elicited. (Fig. 208.)

FIG. 208.



Inguinal hernia with hydrocele. (Kocher.)

From hæmatocele the more rapid growth of the swelling, the history of an injury or recent tapping, and the absence of thrill and translucency, will sometimes aid in the diagnosis, but when the tunic of the hydrocele is thickened or when its contents are opaque diagnosis is impossible.

These same conditions render the diagnosis from tumor difficult. Tumor, however, is heavier and denser than hydrocele, exhibits marked dilatation of the vessels of the cord and scrotum, and is attended by lymphatic enlargement (lumbar and sacral glands). In case of doubt, incision is indicated.

Prognosis.—Spontaneous cure is comparatively common in children. It hardly ever takes place in adults. So far as life is concerned, hydrocele is not dangerous, though it encourages the development of hernia, may lead to testicular atrophy, and occasionally suppurates. As a result of traumatism it may rupture into the tissues of the scrotum.

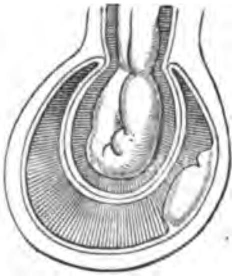
Treatment.—The hydrocele of infants usually seems to be cured by the application of slightly stimulating lotions, such as ammonium muriate ten grains to the ounce of water, or an aqueous solution of ichthyol three per cent. The efficiency of these applications is questionable, and it is probable that when the effusion disappears this occurs spontaneously, practically uninfluenced by the local treatment.

The operative treatment may be palliative or radical.

Palliative treatment consists in evacuation of the fluid contents of the hydrocele. In the chronic form of the disease there is always reaccumulation, but this tapping may be repeated from time to time as the necessity for it is indicated by full distention.

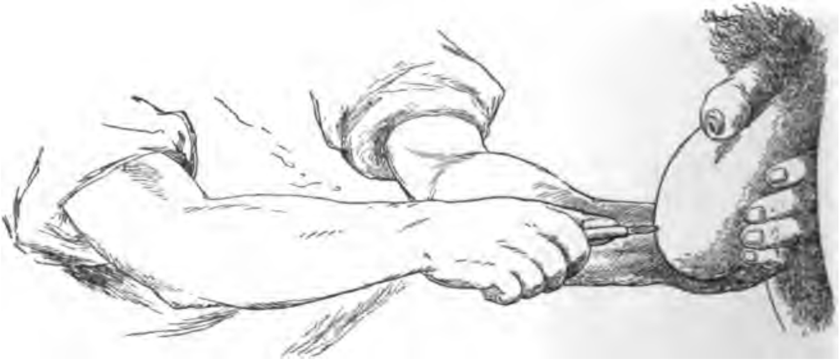
The position of the testicle is first determined by means of the light test and by palpation; it is usually found behind the sac and somewhat below its middle third. The presence of hernia must be carefully excluded. Exceptionally the gut becomes invaginated into the sac of a hydrocele, and might then readily be wounded by the trocar. (Fig. 209.) The patient lies either flat on his back or in a semi-recumbent position. The skin of the scrotum having been thoroughly disinfected, the sac is made tense by seizing it from behind with the left hand. The trocar is plunged into the anterior part in an upward and backward direction, care being taken to avoid any superficial vein which may be apparent; the depth to whch the trocar is plunged should be limited by keeping the thumb- or finger-nail in contact with the canula at one and a half or two inches from the point of the instrument. (Fig. 210.) By observing this precaution and by thrusting the trocar in the proper direction all danger of wounding the testicle is avoided, especially if its position has been before determined. When the sac has been emptied, the canula is immediately withdrawn and the small opening is closed by a fragment of gauze held in place by iodoform collodion. In performing this operation it is important to have the trocar sharp and the

FIG. 209.



Inguinal hernia invaginating the upper portion of the sac of a hydrocele. (Kocher.)

FIG. 210.



Tapping a hydrocele.

canula accurately fitted to it, as otherwise the sac will be pushed before the point of the instrument and will not be opened. Practically the only complication which can occur, save septic infection, is wounding of either the testicle or a large vein, with the effusion of blood into the hydrocele sac or the cellular substance of the scrotum. Elevation and pressure applied by the crossed of the perineum are usually sufficient to check this bleeding.

The radical treatment of hydrocele is carried out either by injection or by cutting operation.

Injection Treatment.—The injection treatment is based on the fact that if a strong irritant is thrown into the hydrocele sac there results a fibrinous effusion, which undergoes organization, obliterating the cavity of this sac. The irritants used are tincture of iodine and carbolic acid, the quantities varying somewhat in accordance with the amount of serous surface to be irritated. Of the former drug, from two drachms to an ounce is employed; of the latter, about twenty minims. For the performance of this operation an anæsthetic is not usually required. The fluid contents of the hydrocele are evacuated, as in the palliative treatment. After the sac is completely empty, iodine or carbolic acid is driven in through the canula, and an effort is made by manipulation to spread it over the entire serous surface of the hydrocele sac. This portion of the operation is important, but is often neglected. The nozzle of the syringe employed for the injection should accurately fit the canula, and after the injection of a quantity of iodine tincture equal to one-eighth of the amount of fluid drawn from the sac, the canula should be withdrawn without disconnecting the syringe from it, the opening being immediately closed by a pledget of antiseptic cotton and iodoform collodion. When tincture of iodine is used there results at the time of injection a sickening pain, radiating to the small of the back and lasting from five minutes to two or three hours. There is rapid swelling, with all the symptoms of acute inflammation; within two days the tumor is as large as before operation, or even larger. This is occasioned by the abundant inflammatory effusion. Within four days this will probably begin to subside, and in three or four weeks will have entirely disappeared. During the acute inflammatory stage the scrotum is kept elevated and is dressed with evaporating lotions. The injection is usually followed by a temperature ranging between 99° and 103° F. for the first three days, after which it drops to normal. When carbolic acid is employed the pain at the time of injection is more transitory and the inflammatory reaction is less marked.

The pain following the injection of iodine may be prevented by eucaine; after evacuating the contents of the sac, two drachms of a four per cent. solution of eucaine are injected and allowed to remain for five minutes, the solution being gently manipulated in the mean time so that the anæsthetic fluid may reach the entire serous surface. The eucaine solution is now drained away and the iodine solution injected. Coley and Satterwhite have reported admirable results from three-minim injections of chemically pure carbolic acid after thorough evacuation of the contents of the sac. This treatment has been particularly efficacious in the treatment of infantile hydrocele.

The fluid is completely withdrawn by means of a small trocar and canula. Through the latter a long blunt needle attached to a hypodermic syringe is passed and three minims of the acid are injected. The needle and canula are withdrawn together and the scrotum is so thoroughly manipulated that the acid comes in contact with the entire serous surface.

The injection operation sometimes fails. Failure may be due—

(1) To an insufficient quantity of the irritant; (2) to too great dilution of the irritant incident to imperfect emptying of the hydrocele sac; (3) to neglect in so rubbing and manipulating the scrotum that the injected fluid penetrates all parts of the serous sac; (4) to such a thickening of the tunica vaginalis that complete collapse of the sac is impossible.

The method of injection is not applicable in cases of congenital, bilocular, multilocular, or encysted hydrocele.

Incision and Drainage.—This method consists in opening the sac by a free vertical incision. All the preparations for a formal operation are made, and the patient is given a local or a general anæsthetic. General anæsthesia is not absolutely necessary. Percutaneous infiltration with Schleich's stronger solution or a one per cent. solution of eucaine will render the skin incision painless. The injection should be driven along the entire line of the incision, and should infiltrate the skin and deeper connective tissue. The parietal layer of the vaginal tunic is not sensitive. The visceral layer is usually acutely sensitive, the application of the finger or even of a smooth pair of forceps to this surface producing the peculiar sickening testicular pain. An incision two or three inches in length is made through the tissues of the scrotum along the anterior and lower portion of the swelling, and is deepened until it enters the tunica vaginalis. The margins of this tunic are stitched to the skin wound by a continuous catgut suture, the entire serous surface is swabbed with pure carbolic acid or iodine tincture, and two large drainage-tubes are introduced, one carried to the top and the other to the bottom of the sac. Or these may be substituted by gauze packing, in which case the dressing is renewed at intervals of from three to five days. The wound is dressed with an abundance of antiseptic gauze and cotton secured in place by the crossed of the perineum. The dressing is repeated daily, the sac being washed out with a mild sublimate solution,—1 to 3000, —and the drainage-tubes shortened as rapidly as possible. The stitches are taken out at the end of the first week. This operation is indicated—(1) when injection has failed to cure; (2) when the sac is obviously so thickened that injection gives little promise of cure; (3) in cases complicated by congenital hernia.

Excision.—Excision of the parietal layer of the tunica vaginalis is performed by dissecting this tunic from the tissues of the scrotum and cutting it away, leaving only sufficient to serve as a normal covering for the testicle, or even less than this.

The field of operation is prepared in accordance with general surgical principles. The sac is made tense by an assistant, and the scrotal covering is divided by a vertical cut running from the top to the bottom of the tumor. After complete hæmostasis the vaginal tunic is incised sufficiently to admit a finger, and the condition and position of the testicle are clearly defined. The remainder of the sac is then split up with a blunt pair of scissors, and the tunica vaginalis is dissected from the scrotum. This can usually be accomplished by rough sponging, and tearing with the fingers, or by the use of the blunt dissector. The bleeding points should be picked up with hæmostatic forceps, which should be left on until the operation is completed. When the parietal layer has been dissected free it should be cut away from the testicle and epididymis as closely as possible. Cysts or fibrous bodies attached to the visceral portion of the sac should be removed. The wound should be closed without drainage.

This operation may be variously modified. Enough of the vaginal tunic may be left to cover the testicle; the edges of the vaginal tunic may be sutured to the borders of the skin wound and gauze drainage may be employed; or the vaginal tunic may be inverted by a couple of sutures, folding it behind the epididymis, the skin wound being closed without drainage.

The external dressing should be antiseptic and compressing (crossed of the perineum), and great care should be taken to prevent infection from soiling of the dressing with urine or fæces. Sutures are removed on the third to the fifth day. Packing is replaced at this time, but very little gauze is used. Drainage is dispensed with altogether in from seven to ten days. The main complication of this operation is suppuration, which is avoidable. It is indicated when incision and drainage fail, and primarily when the walls of the sac are thick and degenerated.

Zancarol has operated upon fifty-eight patients without a single failure by making a long incision, excising a large portion of the vaginal tunic and suturing without drainage. Augagneur reports sixty completely successful cases.

Choice of Operation.—Injection is successful in the great majority of simple cases, and possesses the advantages that it requires no anæsthetic, that after-treatment of an open wound is not necessary, and that the convalescence is comparatively sure.

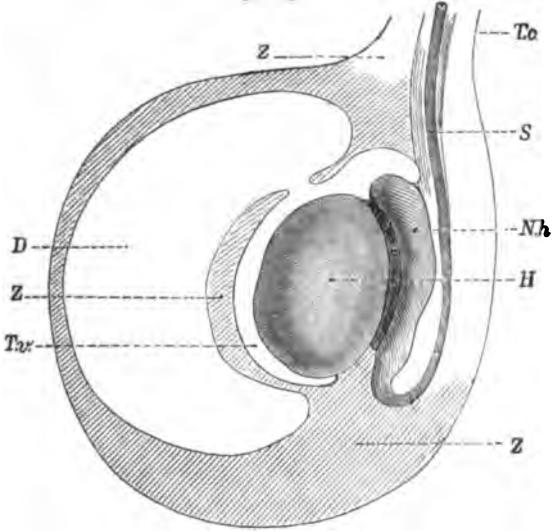
Antiseptic incision should be selected (1) in cases of previous failure with injection; (2) where the sac is very large and has thick walls; (3) where, because of ill health or lessened resistance, the risk of inflammation after iodine is injected is especially to be dreaded; (4) in cases of congenital hydrocele; (5) where the surgeon is desirous of exploring the testicle, as, for instance, when, in addition to the hydrocele, there is testicular enlargement of doubtful nature; (6) when the hydrocele is bilocular, multilocular, or encysted; (7) in some cases of hydrocele complicated with hernia,—*i.e.*, when the bowel is irreducible, and from the lessened resistance of the patient's tissues there is a risk of the inflammation set up by the iodine extending to the hernial sac.

Exceptionally the scrotal hydrocele is bilocular,—that is, there are two distinct cavities filled with fluid and communicating with each other by a comparatively narrow opening. One variety of this bilocular formation is described by Curling. It is due to the distention of the visceral portion of the vaginal tunic passing between the body of the testis and the epididymis. Normally, in this position there is a pouch, which, under tension, may extend, forming a tumor, to the inner side of the testis; the opening into this accumulation is from the outer side. Béraud has described two cases of diverticular development (Fig. 211) due to the lessened resistance of a certain portion of the parietal vaginal tunic, which, yielding to the pressure of effusion, forms a distinct pouch.

There is a perineal form of bilocular hydrocele dependent upon trauma, causing rupture of a pre-existing hydrocele and an effusion of the contents into the perineum. This effusion becomes encapsulated. These bilocular hydroceles are usually translucent, but may reveal on examination two distinct sacs, which may be shown by alternate pressure to communicate with each other.

Multilocular hydrocele of the testicle may be hereditary or may be due to inflammatory adhesions, which by causing agglutination between the folds of the vaginal tunic, but without obliterating it, leave a number of cavities into which serum can be exuded. On palpation the tumor will be found somewhat irregular in outline, and aspiration will evacuate only a small portion of its contents, not materially diminishing the tension of the rest of the tumor.

FIG. 211.



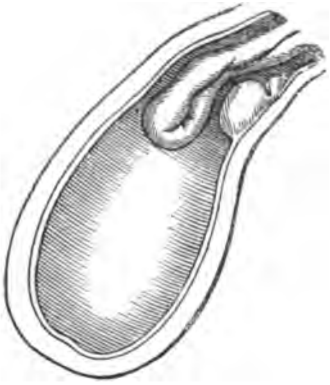
Bilocular hydrocele. (Béraud.) *H*, testicle; *N.h*, epididymis; *S*, vas; *T.v*, cavity of the tunica vaginalis; *D*, cavity of the diverticulum; *T.c*, tunica vaginalis communis; *Z*, cellular tissue between the tunica propria and the tunica communis. (Kocher.)

Excision of the sac is the only means of treatment applicable to this form of hydrocele.

Congenital Hydrocele.—This form of hydrocele depends for its existence upon the maintenance of a communication between the tunica vaginalis and the abdominal cavity. The funicular portion of the tunic does not become obliterated. The fluid may come from the general abdominal cavity or may be exuded from the vaginal tunic. It may develop in early infancy or not until later life.

Symptoms.—When the vaginal tunic forms a pouch which opens into the general peritoneal cavity and there is serous effusion into this pouch, there will be the customary symptoms of hydrocele, obscured only by the facts that on recumbency the tumor disappears, to reappear when the patient assumes the erect position, that there is distinct impulse on coughing, and that by bimanual pressure the tumor can be partially reduced into the abdominal cavity. After the tumor has disappeared on recumbency, even though gentle pressure be maintained on the external ring there will be reaccumulation on rising. This form of hydrocele is occasionally complicated by congenital hernia (Fig. 212), though the opening into the abdominal cavity is usually too small to allow the intestine or omentum to pass through it.

FIG. 212.



Congenital hydrocele with hernia.

This form of hydrocele is comparatively rare. Though we have frequently seen children exhibiting a hydrocele which their mothers stated grew much smaller during the night, we have observed very few cases in which the tumor could be made to disappear during an examination.

Diagnosis.—Hydrocele in children is so extensively translucent that this characteristic of the growth can often be perceived by daylight through the thin tissues of the scrotum. The only affection with which congenital hydrocele is likely to be confounded is hernia. Both tumors give impulse on coughing, and are reducible. The hernia, however, is often resonant on percussion, goes back suddenly with a distinct "flop," and will not return if light pressure is maintained over the external ring; or, should it overcome this pressure, the omentum or gut will be felt to slide beneath the finger. The hydrocele is dull on percussion, is reduced rather gradually without a distinct "flop," and returns when the patient is in the erect position, even though light pressure be maintained over the external ring, the swelling forming gradually at the bottom of the scrotum, and without the sensation of a body sliding beneath the finger.

Prognosis.—This is good, as these hydroceles commonly disappear spontaneously with obliteration of the funicular portion of the vaginal tunic.

Treatment.—The obliteration of the vaginal tunic is favored by the application of a truss, which may be required for the treatment of the coexistent hernia. In case the truss is not successful the fluid should be aspirated. Should it reaccumulate, permanent drainage is secured by means of a small drainage-tube passed through and through the sac. The scrotum is then enveloped in sterile gauze generously applied, and protected from contamination with urine and fæces by an outer investment of rubber or oiled silk. This dressing should be frequently changed. Since the tunica vaginalis communicates directly with the peritoneal cavity, the importance of absolute cleanliness in operating on congenital hydrocele is evident. We have known of one death from peritonitis following the careless application of a seton.

The best operation, and one which should be followed, as a rule, when the consent of the parents can be obtained, is that of antiseptic incision with the performance of a radical operation for the cure of any hernia that may be present, and closure of the abdominal ring in any case. The patient is prepared as for the operation for hernia, and an incision similar to that for a radical cure is made. The funiculo-vaginal process, being identified, is carefully separated from the surrounding tissues and from the cord, divided a short distance above the testis, and converted into a tunica vaginalis. The remaining portion separated from the surrounding structures is treated as the sac of a hernia, and radical cure is performed by Bassini's method.

Infantile Hydrocele.—This is an effusion into a sac formed by more or less of the unobliterated funicular portion of the vaginal tunic. This sac is closed from the peritoneal cavity above, and communicates with the tunica vaginalis testis below.

Symptoms.—The symptoms are those of hydrocele extending well up along the cord. The tumor shows no change in tension on recumbency.

Treatment.—Simple evacuation with the finest needle of the aspirator may be followed by cure, since there is a natural tendency towards obliteration of the sac on evacuation of its contents.

Should this be unsuccessful, the use of carbolic acid injections may be tried. The fluid should be drawn off with a large hypodermic needle, and from one to three minims of carbolic acid injected; this should be gently diffused through the sac.

The insertion of a small drainage-tube, indeed, any of the well-recognized forms of treatment, will give satisfactory results.

Jacobson advises, as a rule, acupuncture. The swelling is made tense, and half a dozen punctures are made into the front and lower surfaces with an ordinary surgical needle, which should be slightly rotated before it is withdrawn. Jets of fluid follow each puncture; there is a good deal of oozing, as well as some escape of fluid into the cellular tissues of the scrotum. Dilute lead water is subsequently applied, and the parts are supported.

BILOCULAR HYDROCELE.—This is a comparatively rare form of infantile hydrocele. The funicular portion of the tunica vaginalis is commonly obliterated at the internal ring. Below this the whole tunica vaginalis may be patulous, or it may be closed just above the position of the testis. As the fluid accumulates, sacculation develops, the tumor extending either backward and downward into the pelvis, or more commonly upward and inward between the abdominal muscles and the peritoneum.

Symptoms.—In addition to the ordinary symptoms of hydrocele—*i.e.*, fluctuation, dulness on percussion, translucency, and smooth surface—there will be found a constriction separating the tumor into two portions. Alternate pressure will show that the fluid in these portions intercommunicates, and exceptionally, when tension is not great, the opening of communication may be distinctly felt. It is usually placed at the external ring. The scrotal tumor is smaller than that formed in the abdominal parietes. There is distinct impulse on coughing. The forms of bilocular hydrocele of the tunica vaginalis testis have been described.

Treatment.—Bilocular hydrocele is best treated by incision, with removal of the sac, or as much of it as is accessible. Care should be taken to avoid opening the general peritoneal cavity.

Inguinal Hydrocele.—The hydrocele which forms in the vaginal tunic of the undescended testicle may be of the ordinary variety or may be congenital, communication persisting between the vaginal tunic and the general peritoneal cavity. We have seen it distinctly bilocular, one pouch passing upward for three inches between the peritoneum and the transversalis fascia, the second pouch extending through the external ring and forming a tumor in the scrotum.

Symptoms.—The symptoms are those already given as characteristic of hydrocele, except that the tumor is formed in the inguinal region.

Treatment.—Since it is very difficult to exclude the presence of hernia, inguinal hydrocele should be treated by open incision, the sac being partly or completely removed and drainage established. When the testis is wasted the appropriate operation is castration.

Fatty Hydrocele.—This has been variously described as chylous or milky hydrocele, and is the name given to a collection of fluid resembling milk or chyle in the tunica vaginalis testis. It may be produced by lymphorrhagia following an actual rupture of the lymphatic channels or by leakage of lymph through the walls of the vessels. This latter method is the more common, and is dependent upon obstruction to the return of the lymph, either by an inflammatory process or by the presence of filariæ.

It has been maintained that the presence of fat is due to degenerative changes occurring in a simple hydrocele. Whatever the causation, the density of the contained fluid renders diagnosis difficult, since translucency is lacking. The other symptoms of hydrocele are present. If the effusion is double and the patient is an inhabitant of a tropical climate, an examination for filariæ should be made.

Treatment.—Excision of the sac is indicated.

HYDROCELE OF THE CORD.

Acute Hydrocele of the Cord.—This is a rare condition, seen most frequently in young subjects after strain. A translucent swelling forms, containing fluid resembling that of ordinary hydrocele. The effusion is limited by the investment of the cord, and is rather an acute œdema into loose cellular tissue than an effusion of fluid into a sac.

Mollière holds that this acute œdema is due to rheumatismal funiculitis. The affection develops with local inflammatory phenomena, but without much pain.

It may simulate an incarcerated hernia, but may be distinguished by its translucency, and by dulness on percussion and absence of abdominal symptoms. The swelling may involve the entire cord, transforming it into a soft sausage-shaped mass.

Treatment.—Compresses wet in dilute lead water and alcohol and held in place by a crossed of the perineum gauze bandage will limit the swelling.

Diffuse Hydrocele of the Cord.—This is a general infiltration into the cellular tissue enclosed by the fascia which invests the cord. The tunica vaginalis is not affected; indeed, the funicular portion of this tunic is usually completely obliterated. The etiology is obscure, but is probably dependent on passive exudation from the veins and lymphatics of the cord due to pressure interference with return circulation. It is not associated with general œdema of the penis and scrotum, since the fibrous tunic of the cord entirely separates this structure from the cellular tissue lying beneath the deep layer of the superficial fascia.

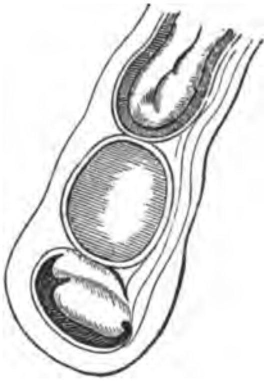
Symptoms.—The tumor forms gradually, with very few symptoms. It may involve the entire length of the cord, reaching from the testicle to the internal ring and filling the inguinal canal. It is broader in its lower portion, and may cover the upper portion of the testis and epididymis as a cap. On placing the patient on his back and elevating the testicle the swelling gradually diminishes, but does not disappear entirely. On gentle continued pressure deep pitting may be detected. The infiltration is painless unless it be a sequel of acute inflammation, is doughy rather than fluctuating, and gives the test of translucency.

The differential diagnosis must be made from omental hernia. This gives a more distinct impulse on coughing, is not so smooth, can be reduced suddenly and completely, and is very feebly translucent. In irreducible omental hernias of fat people a pre-operative diagnosis may be impossible.

Treatment.—When the infiltration produces a tumor of such size as to cause inconvenience from its bulk, incision and drainage are indicated.

Encysted hydrocele of the cord, or funicular hydrocele, consists of an accumulation of fluid within an unobliterated portion of the funicular portion of the tunica vaginalis. This accumulation is closed from the peritoneal cavity above and from the tunica vaginalis testis below. The hydrocele may be unilocular, bilocular, or multilocular, in the latter case forming a series of small cysts along the course of the cord. These cysts may be placed in the inguinal canal, and are more common on the right side. They are usually observed in children, and may be complicated by hernia. (Fig. 213.)

FIG. 213.



Inguinal hernia, with hydrocele of the cord. (Kocher.)

Symptoms.—A smooth, dense, ovoid, fluctuating swelling is formed in some portion of the spermatic cord. By transmitted light the tumor is found to be translucent, and the testicle can usually be recognized below it.

Diagnosis.—This is based on the position of the cyst or cysts. Encysted hydrocele of the testicle, though sometimes extending upward along the cord, is attached to the testis and the epididymis. In hydrocele of the cord palpation will show that the tumor is not directly connected with the testicle. Hydrocele of the cord is distinguished from hernia by absence of impulse on coughing, inability to reduce the tumor entirely within the abdominal cavity, though it is often easily pressed back into the inguinal canal, and absence of tympany and gurgling. The hernia is not translucent.

Treatment.—In children spontaneous cure may occur. Incision followed by drainage is probably the safest method of treatment, and the one most certain to effect cure. Multiple puncture is also efficient. In elderly people, where radical measures are not desired, repeated tappings will be necessary to afford relief.

Hydrocele into a Hernial Sac.—An effusion of serum which may closely simulate hydrocele may take place into the sac of an inguinal or a scrotal hernia. This sac may have become obliterated from the general peritoneal cavity and contain only fluid, or it may contain in addition to the fluid a portion of gut or omentum, the hernia being incarcerated. There is always more or less effusion in combination with incarcerated hernia, and the sac not infrequently becomes thickened and fibrous, closely resembling the investment of chronic hydrocele or a hæmatocele. The symptoms are those of a hernia followed by the development of a fluctuating, probably translucent tumor. When the sac contains both fluid and intestinal contents, tenderness and possibly resonance in the inguinal region may lead to a correct diagnosis. Frequently the diagnosis is made only after incision.

Treatment.—Excision of the sac and an operation for the radical cure of the hernia constitute the only practicable treatment.

HÆMATOCELE.

Hæmatocele is a collection of blood or bloody fluid in the vaginal tunic of the testicle or cord or in the substance of either of these structures. As is the case with hydrocele, the effusion may be acute or chronic.

Hæmatocele of the Tunica Vaginalis.—This affection as compared with hydrocele is very rare. It may develop in the acute form as a result of punctured wound or rupture of the testis, or may be caused by a blow or by violent muscular strain. Svalin noted blood effusion into the tunica vaginalis and the scrotal tissues after severe coughing. There may be bleeding into a previously healthy tunica vaginalis; commonly it is into a previously inflamed sac, and often it occurs as a complication of hydrocele. It may be complicated by scrotal hæmatoma.

The development of acute hæmatocele (hæmatoma) is characterized by severe pain, which may be sickening in character, and the rapid formation of a tumor.

This tumor completely envelops the testicle, and closely corresponds to it in shape.

The blood may coagulate or remain fluid. The tumor never reaches large dimensions, since it forms so rapidly that the tunica vaginalis ruptures, thus allowing the blood to escape into the scrotal tissues.

Symptoms.—The distention of the vaginal tunic is usually obscured by the concomitant scrotal blood effusion. After this has been absorbed there may be found a fluctuating tumor impervious to light and giving on exploratory puncture blood or blood-stained fluid.

Exceptionally complete resolution takes place. Usually the tunica vaginalis undergoes the alterations characteristic of chronic hydrocele.

Treatment.—Acute hæmatocele incident to trauma is treated by rest, elevation of the parts, and the application of evaporating lotions or the ice-bag. If the swelling is rapid and progressive, clots should be evacuated through an incision, followed by search for the bleeding vessel. The scrotal infiltration is quickly absorbed. If on its disappearance the vaginal tunic is found distended, its contents should be evacuated through a free incision, since otherwise the tunica vaginalis becomes chronically inflamed and a chronic hæmatocele may form.

Chronic Hæmatocele of the Tunica Vaginalis.—This affection is dependent upon chronic inflammation of the tunica vaginalis, and is properly called peri-orchitis hæmorrhagica or hæmorrhagic vaginalitis. The blood effusion is simply a symptom of such inflammation, which, in turn, is generally regarded as secondary to disease of the epididymis or of the testis.

Gosselin recognizes three degrees of hæmatocele, basing his classification upon the extent of lesion which the walls of the sac show. The first degree is characterized by moderate thickening, the vaginal tunic being but little altered beyond some increase in vascularity. There is a deposit of thin, non-adherent false membrane. On evacuation of its contents the sac will collapse. The second degree is characterized by increased thickness of both the vaginal tunic and the false membranes, but the walls are too rigid to collapse on evacuation of the contents of the sac. The condition is progressive.

The third degree is characterized by still greater thickening and rigidity. Areas of cartilaginous and calcareous transformation are observed. Barigandin described a case of ossification of the tunica vaginalis. In the thickened walls are often found foci of soft granulation-tissue or interstitial hemorrhages. The false membrane, at first deposited in a thin layer and extremely vascular, ultimately has its blood-supply greatly diminished or entirely cut off by organization and contraction of the inflammatory infiltrate, and it is likely to slough. In old cases it is so intimately connected with the tunica propria that it is impossible to strip it from the latter.

The thickened sac is made up partly of fibrinous deposits and partly by organization of the infiltrate into the subserous connective tissue.

On incising a hæmatocele blood more or less altered or blood mingled with the fluid of the hydrocele is found. In old cases the blood is altered both in color and in consistence. It may form a chocolate-colored or black syrupy, or even a gelatinous mass. When the bleeding is into the sac of a hydrocele the fluid is clear red and contains clots.

In recent cases—*i.e.*, those in which the sac is not greatly thickened—the testicle may not be appreciably altered, even though the tumor is of great size. As induration and thickening, in consequence of subserous infiltration and organization, take place, the albuginea becomes involved, together with its fibrous trabeculæ, and there results an atrophy of the tubules with fatty degeneration of their epithelium. In the large, greatly thickened, degenerated sacs careful search may fail to discover even a trace of the testis.

The testicle usually lies in the lower posterior portion of the tumor. In the early stages of development, before the gland has atrophied, palpation, eliciting testicular sensation, will probably enable the surgeon to determine its exact position. In the late stages of hæmatocele where the sac is greatly thickened it may be impossible to determine whether the testicle lies in front of or behind the swelling. In such a case operation should be conducted with great care, the tissues being examined before they are cut.

Chronic hæmatocele is of slow formation, and is most common between the fortieth and the sixtieth year of age. It may grow steadily, or may rapidly increase in size after brief intervals of quiescence. The tumor is hard, painless, ovoid or pyriform in shape, with smooth or bosselated surface, showing at times spots of softening and possibly dense areas of calcareous degeneration.

Diagnosis.—This is founded on the smooth bossed surface, the rounded or oval shape, the tense, elastic feel, the varying consistence, and the absence in any portion of the tumor of either a projection or a depression corresponding to the position of the testicle or the epididymis. There is usually a history of traumatism, strain, or preexisting hydrocele. The general growth of the tumor is slow, but it exhibits irregularly recurring periods of rapid increase in size, attended by pain, heat, and swelling. These sudden increments are due to fresh hemorrhages into the sac. The tumor is not translucent. The final diagnosis depends upon aspiration. For the purpose of thus confirming the diagnosis a needle longer than that employed in the ordinary hypodermic syringe is required, and it must be remembered that the contents of the sac will not necessarily be obviously bloody.

Omental hernia may strongly resemble a chronic hæmatocele. The latter, however, begins within the scrotum, gives no history of having been reducible at any period of its development, and usually involves only the lower portion of the cord, the inguinal canal remaining free. Unless the hæmatocele extends well up into the inguinal canal there will be no impulse on coughing.

The distinction from hydrocele is dependent upon absence of distinct thrill and fluctuation, failure to detect translucency, and finally the result of exploratory tapping or incision. Diagnosis from chronic orchitis or malignant growths may be absolutely impossible, except from the history. In case of doubt there should be no hesitation in deciding the matter by an aseptic incision.

Prognosis.—There is no tendency towards spontaneous cure. The disease may, however, become self-limited. It usually progresses, forming ultimately a large tumor, which inconveniences mainly by its bulk and by the pain and disability dependent upon the intercurrent attacks of acute inflammation. Even though the patient experiences no mechanical inconvenience from the growth, it inevitably destroys the secreting function of the testicle and predisposes to suppuration and to malignant degeneration. Suppuration may follow the use of an apparently clean trocar, since the conditions are exceedingly favorable to germ-growth. At times it occurs from hæmatogenous infection, the predisposing cause being trauma. The hæmatocele and the scrotum of the affected side become œdematous and painful, the symptoms of constitutional infection develop, and softening takes place, followed by grumous discharge. Some cases of malignant degeneration of hæmatocele have been recorded. It is probable, however, that in these the hæmatocele complicated cancer and developed secondarily.

Treatment.—Chronic hæmatocele should be treated by incision and curetting, decortication, or castration. Tapping and injection of iodine, and even simple incision, operations usually curative in the case of hydrocele, are insufficient.

Incision followed by curetting is the simplest and most easily performed of the radical operations, and is successful when the walls of the sac have not become extensively infiltrated and rigid. The cavity of the cyst is opened by a free incision, which, unless the position of the testicle has been determined previously, is deepened with the utmost precaution. The contents of the sac are washed out, and the whole interior is scraped smooth with a sharp curette. So much of the outer wall of the vaginal tunic as can be easily freed is cut away, and the remaining portion is sewed to the skin. The cavity is then loosely packed with iodoform gauze, and is allowed to heal by granulation.

When, because of great thickening and rigidity, with cartilaginous or calcareous deposits, it is evidently impossible for the walls of the sac to come together and become obliterated, or even to produce healthy granulations, decortication is indicated. This is practised by opening the tunica vaginalis and tearing and dissecting away from it the thick layers of false membrane by means of the finger or by rough sponging; more often the knife or scissors are required. When the false membrane has been reflected as closely as possible to the testis and cord without wounding these structures, it is cut away, the edges of the vaginal tunic are sutured to the skin, and the wound is lightly packed.

Castration is indicated in long-standing hæmatoceles in old subjects when there is reason to believe that the testicle is partially or completely atrophied and the patient is not in a condition to stand a prolonged operation.

Encysted Hæmatocele of the Testis.—This is an extravasation of blood into an encysted hydrocele. The symptoms are those of sudden increase of a pre-existing encysted hydrocele, with inflammatory phenomena. The tumor fluctuates at first, but is not translucent.

Treatment.—Either total excision of the sac or castration is indicated.

Intratesticular Hæmatocele is due to traumatism. After an injury persistent pain and swelling not dependent on hydrocele might suggest parenchymatous effusion of blood, though, except by puncture, an early diagnosis from acute orchitis would be impossible. The pain of these hæmatomata is said to be extremely severe and persistent. The detection of a fluctuating area in the testicle proper would indicate incision and drainage.

Parenchymatous hæmatocele of the epididymis is reported by Jacobson.

Treatment.—Immediately following injury of the testicle, rest, elevation of the parts, and the application of evaporating lotions are indicated. Later, on the subsidence of acute inflammatory phenomena, the pressure suspensory bandage should be worn. If the pain remains intense, the testicle showing a moderate increase in size not dependent upon hydrocele, exploratory puncture of this gland with the finest needle of the aspirator is indicated, since these symptoms may be due to a hæmatoma, which, if allowed to remain, may produce total disorganization of the testicle. The aspirating needle should be thrust in at the most painful spot or into any area of obscure softening or fluctuation, if this can be detected. If the needle shows that there is an encysted blood effusion, this should be opened, the blood evacuated, and the cavity drained.

Hæmatocele of the cord may be diffuse or encysted.

Diffuse hæmatocele is usually due to rupture of a vein from direct traumatism or sudden increase of intra-abdominal pressure. There forms quickly a doughy, sausage-shaped tumor, occupying the position of the cord, and entirely obscuring it. This tumor is not translucent.

In the chronic form of diffuse hæmatocele of the cord the blood effusion may reach enormous dimensions. It is characterized by great thickening of the limiting walls.

Treatment.—This has for its object the limitation of effusion and the prevention of inflammatory reaction. The patient is put to bed. A layer of sterile cotton is placed over the cord, and a crossed of the perineum is firmly applied. If in twenty-four hours it is evident that the bleeding has ceased, inflammatory reaction is limited by evaporating lotions or the ice-bag. Should bleeding persist in spite of pressure, incision, securing the bleeding point, and closure of the wound without drainage are indicated.

Encysted hæmatocele of the cord is due to hemorrhage into an encysted hydrocele or to the encysting of a hemorrhage into the cord. It begins in the lower part of the cord, forming a pyriform tumor, with the base down, which ultimately may become merged with the epididymis and testis.

The diagnosis is suggested by the history of the tumor, especially its origin, and the absence of translucency.

Treatment.—Incision, evacuation of clots, and decortication or complete removal of the sac are indicated.

Loose Bodies in the Tunica Vaginalis.—It sometimes happens that on palpation of the testis a rather hard body, about the size of a kidney-bean or smaller than this, may be felt moving freely under the finger. This body is smooth and elastic ; its motion may be limited, or may be so free that the body can be pushed into any portion of the vaginal sac. There is usually a moderate degree of hydrocele of a thickish consistence. These bodies may be cysts with thick walls, sometimes exhibiting calcareous degeneration, the remains of fœtal structures ; they originate beneath the tunica vaginalis, and become pedunculated and finally free, the pedicle rupturing. Floating fibroid and cartilaginous bodies are also found ; these grow from the subserous connective tissue and may become detached and lie loose in the cavity. They are generally small and multiple.

Symptoms.—These bodies are commonly found accidentally, and cause no symptoms beyond a moderate hydrocele, with which they are usually associated. If they cause pain and acute vaginalitis, or if they are encountered during the radical cure of hydrocele, they should be removed.

NEURALGIA OF THE TESTICLES.

Reference has been made already to the intense pain which accompanies inflammatory conditions of the testicle and epididymis. There may, however, be a pain equally severe which occurs without apparent cause in testicles showing no evidence of disease. This pain may be in the testicle or may shoot from this region along the cord in various directions. It may be continuous or regularly or irregularly intermittent. It is symptomatic of what Cooper called "irritable testicle," and is sometimes observed in hysterical patients. Exceptionally the aura of true epilepsy takes the form of neuralgia of the testis.

Many cases supposed to be purely neuralgic are dependent upon distinct lesion. Thus, the pain may be excited by tumors, such as fibromata or myomata, or by parenchymatous blood-cysts, or by the congestions incident to varicocele.

The only symptom of the neuralgia is pain. This may be agonizing in its intensity, and may be associated with tonic or clonic spasm of the cremaster muscle. The testicle is extremely sensitive, even friction of the garments or the slightest touch causing severe suffering. During the paroxysms of pain the testicle may become hard and the vessels of the cord congested. The neuralgia may be dependent upon traces of a previous inflammation, the presence of a hernia, or certain systemic conditions, as gout, rheumatism, or toxæmia. We believe that careful examination will show that the majority of cases are in part due to a varicose condition of the spermatic veins. It is true that varicocele may attain enormous dimensions and yet cause no pain. Even slight dilatation may, however, occasion marked symptoms in those who are hereditarily neurotic.

Treatment.—The first thought, in treating this affection, should be to exclude organic lesions, such as blood-cyst, tubercle, hernia, or varicocele; when it is evident that pain is not dependent upon a local condition which may be remedied by operation, palliative treatment is indicated. A great number of external applications and internal remedies have been used, and often successfully. It must be confessed that certain cases resist every form of treatment. Among the most serviceable therapeutic measures are the pressure suspensory bandage, local applications of heat and cold, counter-irritation, freezing the overlying skin with ethyl chloride, blisters, galvanism, and the ice-bag. Internally there may be given aconitine in full doses, quinine, antipyrin, acetanilid, exalgin, valerian, and hyoscine. The general treatment should be hygienic and, if indicated, anti-rheumatic.

CHAPTER XIX.

INJURIES AND DISEASES OF THE SPERMATIC CORD AND SEMINAL VESICLES.

ATTENTION has been called already to certain anomalies of the cord. Thus, this structure may be absent, even though the testicle is in its normal place, or the two cords may be fused, or one cord may be double. The vas may communicate directly with the ureter, as is normal at one period in fœtal life, or may be entirely wanting in its prostatic portion, or may be fused. The single duct may open into the utricle, or may continue by a distinct passage to the glans penis.

Contusions and Wounds of the Cord.—Contusions rarely cause injury other than an acute hæmatocele, the blood which is poured out from the ruptured veins being limited by the fibrous sheath of the cord, thus forming a sausage-shaped tumor which may extend from the testicle to the internal ring and beyond, filling the inguinal canal. It is usually associated with hemorrhage into the scrotal tissue, which may completely mask it.

Treatment.—Rest, elevation, pressure, and the application of ice during the bleeding stage, followed by evaporating liniments, and possibly massage for the purpose of hastening absorption, outline the treatment.

Wounds of the cord are necessarily attended by free bleeding, for the arrest of which ligatures are required. If the deferent canal is divided, its continuity may be restored by the direct apposition of the thick walls by suture. Division of the vas is not necessarily followed by atrophy of the testicle, even though the operation for the restoration of the continuity of the canal is not performed. When the spermatic artery is divided, and particularly when the plexus of nerves supplying the testicle is extensively injured, atrophy or gangrene is extremely likely to result.

Inflammation of the Cord.—Funiculitis or inflammation of the cord may be acute or chronic.

ACUTE FUNICULITIS may arise from extension of a posterior urethritis along the vas, or from phlebitis, especially that dependent upon rheumatism. Two forms of the affection have been described, serous funiculitis, or acute hydrocele, and phlegmonous funiculitis. It is possible that serous funiculitis (diffuse hydrocele), which forms a rounded, sausage-shaped, pitting, translucent tumor occupying the position of the cord, is in reality sometimes an encysted hydrocele. It occurs as a complication of gonorrhœa or rheumatism.

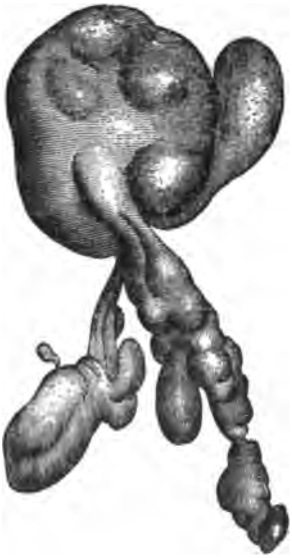
Phlegmonous funiculitis is usually traumatic in origin. It is also caused by gonorrhœal inflammation of the vas and by septic phlebitis. The sausage-shaped tumor is extremely tender, and may develop with symptoms characteristic of strangulated hernia. Should the infiltrate suppurate, it is likely to invade the peritoneal cavity in its upward extension.

Chronic funiculitis is usually tubercular.

Treatment.—Acute funiculitis is treated by rest, elevation, and the application of cold, preferably in the form of evaporating lotions. Should the swelling be so marked as to threaten the vitality of the testis, incision and drainage are indicated.

Tumors of the Cord.—LIPOMA is the most frequent tumor of the cord. It may develop entirely in the scrotal portion of this structure, or may extend along the inguinal canal and into the pelvis. Lipoma may reach a large size: Wilms reports one which weighed twenty pounds. In the course of its growth the lipoma incidentally becomes distinctly lobulated, simulating malignant disease, penetrating between the structures of the cord (Fig. 214), and making entire removal without sacrifice of the testicle impossible. Hence the importance of early treatment.

FIG. 214.



Lipoma of the cord. (Péan.)

Lipoma may undergo myxoid degeneration, and exhibit a tendency to recur on removal.

The symptoms are those of a painless, slow, somewhat irregular, slightly translucent, soft but lobulated growth in the course of the cord.

The diagnosis from omental hernia may be impossible without exploratory incision. Even then the surgeon may be in doubt, but may be guided by remembering that the fatty growth of an epiplocele is within the peritoneal sac and is often adherent to it. The history of lipoma differs from that of hernia, since it gradually develops along the course of the cord, grows upward, is not reducible, and until it involves the inguinal canal will not give an impulse on coughing.

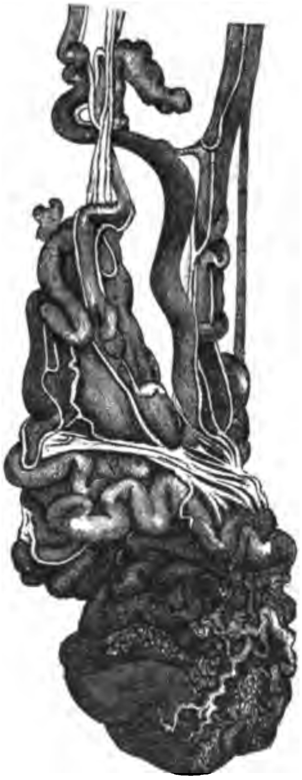
Treatment.—Early operation is always indicated, since when the tumor is small it may be entirely removed without sacrificing the cord. When the tumor has reached a large size and it is impossible to dissect it free from the structures of the cord, castration is indicated.

MYOMA is rare. It may be found together with lipoma, giving a semi-malignant character to an otherwise benign tumor.

SARCOMA and CARCINOMA are more frequent than myxoma. They both cause metastasis and develop as do similar tumors in other regions of the body. They often undergo cystic degeneration.

The treatment is castration, with removal of as much of the cord as possible.

FIG. 215.



Varicocele. (Osborn.) Monod and Terrillon.

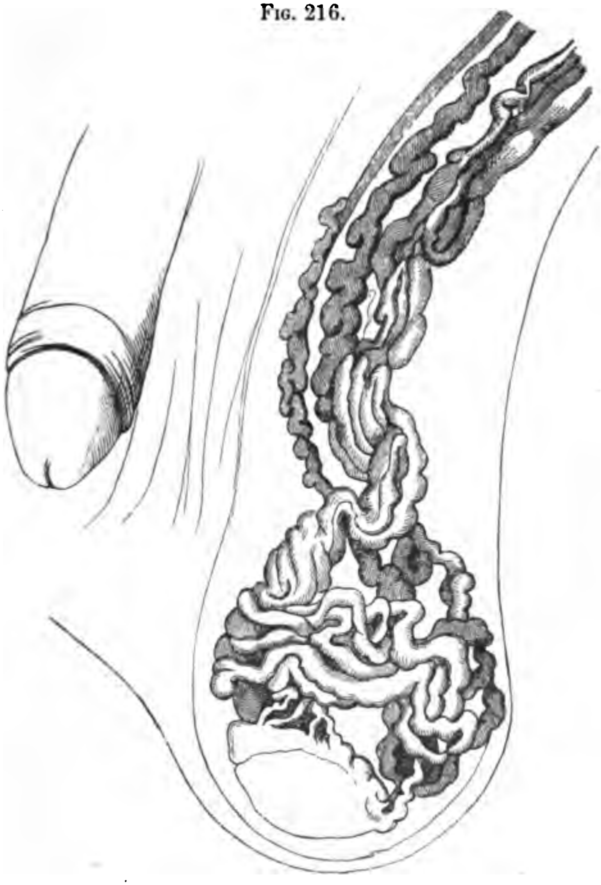
Tuberculosis.—In the course of genito-urinary tuberculosis the vas is frequently infiltrated. This is nearly always secondary to involvement of the epididymis or the prostate. Exceptionally nodules first develop in the vas, the epididymis being apparently healthy. Reclus has observed two such cases: in one the nodule involved the cord at the position of the external ring, in the other it was within the inguinal canal.

In the rare cases of primary involvement of the vas the appropriate treatment would be excision of the affected portion of the canal, followed by an anastomosis by Van Hook's method.

Varicocele, or dilatation and elongation of the veins of the spermatic cord (Figs. 215, 216), is most frequent in early manhood,—that is, from about the fifteenth to the twenty-fifth year; it is rare in infancy; in old age it is of moderate development and causes little inconvenience. The veins of the cord are especially prone to dilatation and elongation from the fact that their valves are insufficient, and hence there is a long column of blood to be supported. The disease usually affects the left testicle (ninety per cent. of cases), possibly because the vein, instead of passing obliquely into the vena cava, as on the right side, enters the renal vein almost at right angles to its long axis, and, moreover, lies behind the rectum.

The veins composing the spermatic plexus can be ranged in three groups, the most anterior of which has in its midst the spermatic artery, the middle the vas deferens, and the posterior those veins which pass upward from the tail of the epididymis. The anterior group is the one first affected, or, if the dilatation affects all the veins, is most extensively involved. Besides the mechanical conditions favoring the development of varicocele, there are other causes, such as prolonged standing or walking, violent muscular exertion, masturbation, sexual excess, traumatism, inflammation, gonorrhœal epididymitis, and tumor-formations in the abdominal cavity, particularly swelling of the lumbar lymphatic glands or involvement of the kidneys. Hernia, heredity, constipation, have all been assigned as etiological factors, but their influence is not proved. Billroth states

FIG. 216.



Dilatation of the veins in a marked case of varicocele. (Kocher.)

that varicocele is due to a diathesis which first affects the vessels of the pampiniform plexus, and later those of the rectum and the leg.

Symptoms.—These may be direct or reflex. The direct symptoms are as follows: The scrotum of the affected side is filled with a tortuous mass of veins, sometimes visible through the skin, and feeling like a bundle of worms. The tumor formed by these veins partly or completely disappears on lying down, but reappears on standing up, increasing in size gradually from below upward. Pressure exerted over the inguinal ring does not prevent the appearance of the tumor. The scrotum is elongated, dusky purplish in color, and in advanced cases the testicle of the side involved is often markedly atrophied.

The reflex symptoms are—(1) pain in the testicle, the lumbar region, the hypogastrium, and often in the penis. It bears no relation to the size of the tumor. It may be agonizing or simply harassing. (2) Sexual neurasthenia, characterized by mental depression, sexual weakness or impotence, headache, nervousness, lack of power of concentrating the mind, and other vague general symptoms.

Varicocele may simulate omental hernia. The hernia has not, however, the characteristic feeling of a bundle of worms; if reduced it will not recur when pressure is made over the external inguinal ring, and it gives a much more distinct succussion on coughing than does varicocele. The development of the two affections is quite different.

Prognosis.—Varicocele observed in young men subject to prolonged and ungratified sexual excitement is usually cured by marriage, or, at least, it ceases to give trouble afterwards. If moderate in degree it has no marked tendency to increase, causes little pain, and does not appreciably alter the nutrition of the testicle. Quénu states that owing to the dilatation of the veins of the nerves there occurs a periphlebitis and neuritis, which would account for both pain and atrophy. Only when varicocele is so pronounced that circulation is materially interfered with does atrophy of the testicle result. Spontaneous cure seldom occurs, except in those rare acute cases which develop with mild inflammatory symptoms in consequence of strain or exposure. There is one form of varicocele frequently noted in old men, due to dilatation of the lower portion of the posterior group of veins and completely masking the lower portion of the epididymis. This is frequently followed by sclerosis of the lower testicular segment.

Treatment.—Treatment may be palliative or radical.

Palliative treatment consists in the proper regulation of the bowels, the avoidance of all exciting causes, such as violent muscular efforts or prolonged standing, the daily application of cold douches to the skin overlying the dilated veins, and the wearing of a properly fitted suspensory bandage. This treatment is indicated when the varicocele is moderate in size, when the nutrition of the testicle is not interfered with, and when the reflex symptoms are not pronounced.

Radical treatment is indicated when the varicocele is progressive and is well developed, when beginning atrophy of the testicle is observable, and when the reflex symptoms, particularly the sexual neurasthenia, are pronounced.

Excision of the affected veins is best performed under ether, though eucaine anæsthesia makes it almost painless. The operator by palpation finds the upper portion of the vas and presses it backward and inward away from the affected veins. An assistant standing to the left of the patient makes firm pressure by means of the thumb and fingers of the right hand at the point which will keep the vas back and the enlarged veins forward. The surgeon, passing his fingers lower down, again separates the vas from the veins, and the assistant, placing the palmar surface of the left hand beneath the scrotum, presses firmly with the thumb and fingers, keeping the lower part of the vas away from the group of dilated veins. By slight tension with the left hand the skin of the scrotum is made taut. The surgeon makes a longitudinal incision two inches in length over the most prominent part of the varicocele, dividing the skin, dartos, and fibrous investment of the cord ; through each lip of this wound is passed a short thread, the two ends of which are seized with hæmostatic forceps ; the weight of the instruments retracts the borders of the incision, thus facilitating subsequent manipulations. The veins are freed by blunt dissection for two or three inches of their course, and an aneurism needle, threaded with catgut, is passed beneath the entire group at the lower end of the incision ; the needle is unthreaded and withdrawn ; another needle, similarly threaded, is passed beneath the veins at the upper end ; thus they are included in two catgut loops separated from each other by an interval of at least two inches. These ligatures are tied tightly with a triple knot, and each is left with one long end. The intermediate portion of the veins is then cut out with scissors, and the stumps are apposed by tying the long ends of the ligatures together. This shortens the cord, and thus raises the testicle. The skin wound is closed without drainage.

In certain cases where the scrotum seems to be unusually lax, excision of the superfluous skin and dartos is indicated. This, if undertaken, should be radical. Enough skin should be taken away so that the flaps are stretched taut over the testes when the wound is closed. Absolute hæmostasis should be secured, and the sutures must be so placed that the skin is not inverted. To prevent recurrence it is at times necessary to combine ligation and resection of the cord with resection of the scrotum.

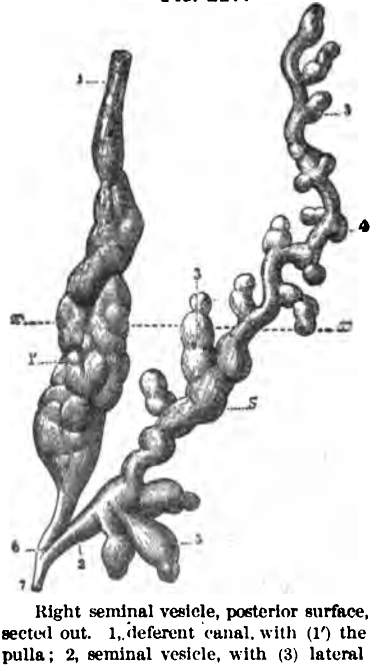
When the posterior group of veins is markedly involved, forming a doughy tumor behind and below the epididymis, these vessels should be ligated and excised, either through a separate incision or through the wound resulting from resection of the scrotum.

The results of the operation are usually satisfactory. Exceptionally atrophy or even gangrene of the testicle follows ligation of the veins of the cord. Sometimes the reflex phenomena are unrelieved or even exaggerated, possibly because the neuritis originally caused by varicocele is progressive.

THE SEMINAL VESICLES.

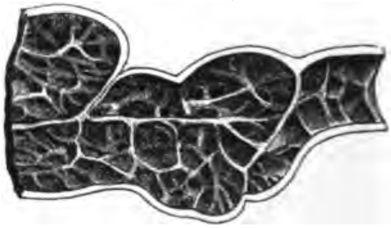
The anatomy of the seminal vesicles has already been briefly outlined. These glands form two lobulated pouches, lying at the base of the bladder. The walls of these pouches are thin, and if carefully dissected can be partly extended in the form of an irregular tube, with cæcal projections and diverticula. (Fig. 217.) The inner surface is irregularly sacculated. (Fig. 218.) The vesicles are enclosed in a dense fascia, which passes from the walls of the bladder to the posterior surface of the prostate. The vesicles in their convoluted form are about two inches in length, three-quarters of an inch in width, and a quarter of an inch in thickness. They terminate in a duct into which the vas empties just before the latter enters the substance

FIG. 217.



Right seminal vesicle, posterior surface, dissected out. 1, deferent canal, with (1') the ampulla; 2, seminal vesicle, with (3) lateral prolongations, (4) cæcal dilatations, and (5) parietal projections; 6, union of the vesicle with the vas; 7, ejaculatory duct; *xx* marks the position of the posterior extremity of the undissected vesicle. (Testut.)

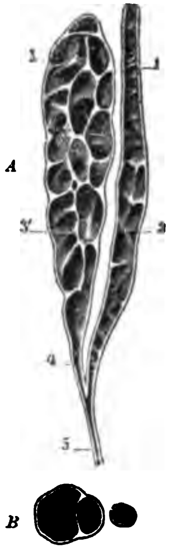
FIG. 218.



Long section of dilated seminal vesicle. (Sappey.)

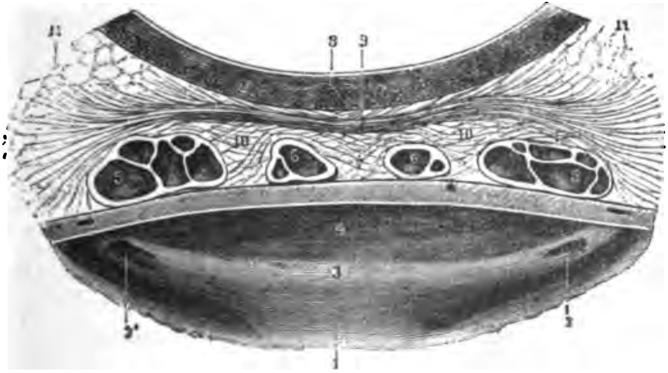
of the prostate. The lower inner portion of each vesicle is usually adherent to the wall of the vas, making a dissection at this point difficult. (Fig. 219.) Above, the two structures are entirely separated, being enclosed in distinct compartments of the dense fascia which passes from the upper posterior wall of the bladder to the base of the prostate. The upper extremities of the seminal vesicles correspond to about the point of entrance of the ureters into the bladder, and are in close relation with the peritoneum, which is here reflected from the posterior wall of the bladder to the rectum. Within the fascia which includes in separate compartments the seminal vesicles and the vasa are found many muscular fibres, apparently originating from the bladder-wall and the posterior surface of the prostate. (Fig. 220.) These fibres are particularly abundant along the under and outer surfaces of the vesicles. The vesicles are somewhat pear-shaped, the narrow end running downward and inward. As is the case with all the sexual organs, they vary greatly in size, bearing no fixed relation to the development of either the individual or the other organs, or even to one another. Thus it is not un-

FIG. 219.



Deferent canal and seminal vesicle. *A*, longitudinal, *B*, transverse section; 1, deferent canal; 2, its ampullated portion; 3, seminal vesicle with (3') pouches; 4, terminal portion; 5, ejaculatory duct. (Testut.)

FIG. 220.

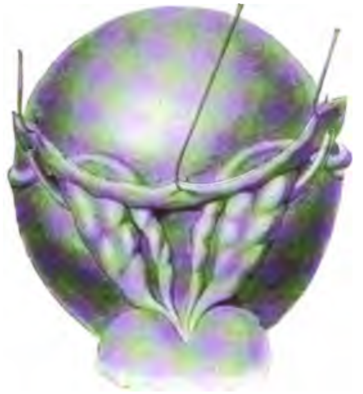


Horizontal section of the bladder and seminal vesicles passing through the lower orifice of the ureters. 1, inner surface of the bladder; 2, 2', ureters; 3, intra-ureteric ridge; 4, bas-fond; 5, seminal vesicles; 6, deferent canals (ampullated portion): 7, interdeferential triangle; 8, rectum; 9, prostato-peritoneal aponeurosis; 10, musculo-fibrous tissue enveloping the vasa and vesicles; 11, 11, cellular tissue of the pelvis. (Testut.)

common to find one vesicle twice or thrice the size of its fellow, without obvious reason for this apparent asymmetry. The portion of the bladder lying between the inner borders of the two seminal vesicles and limited above by a transverse line connecting the two bases corresponds to the position of the vesical trigonum. The vesicles have rather thin walls, made up of fibrous and muscular tissue, lined with mucous membrane in which are found many tubular glands.

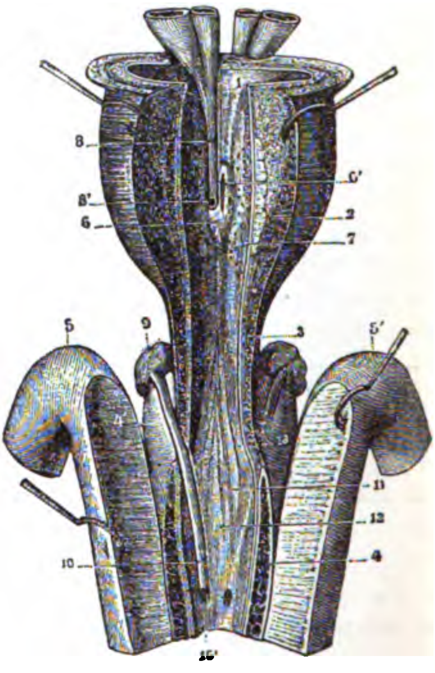
The ejaculatory ducts, formed by a continuation of the seminal vesicles and the vasa deferentia, enter the substance of the posterior prostatic isthmus, passing downward and forward, and opening in the borders of the utricle or within this cavity. The diameter of their orifices is one-half millimetre, while at their origin it is three times as great. (Fig. 222.)

FIG. 221.



Relations at posterior surface of bladder. (Testut.)

FIG. 222.



Posterior urethra exposed by splitting its upper wall. 1, vesical neck; 2, section of the prostate and the urethral sphincters; 3, section of the membranous urethra; 4, section of the spongy urethra; 4', bulb; 5, 5', cavernous bodies; 6, verumontanum, with (6') orifice of the utricle; 7, posterior wall of the prostatic urethra, showing glandular openings; 8, right ejaculatory duct exposed; 8', its orifice; 9, Cowper's gland; 10, its duct exposed; 10', opening of the duct; 11, longitudinal folds of the urethral mucous membrane; 12, bulbar cul-de-sac; 13, narrowing of the bulb at the beginning of the membranous urethra. (Testut.)

The function of the seminal vesicles is probably entirely secretory. Examination usually shows a few spermatozoa, but never a quantity of semen sufficient to suggest that this convoluted tube is a receiver and storer of the secretion from the testicle, such, for instance, as is the gall-bladder for the secretion of the liver.

The vesicles receive their blood-supply from the inferior vesical and middle hemorrhoidal arteries. The nerves come from the hypogastric plexus.

Anomalies of the Seminal Vesicles.—The seminal vesicles may be absent. In this case there is usually absence of the testicles, though Tenon and others have reported cases of bilateral absence where the testicles were still present; there were, however, other deformities. Unilateral absence has been noted in conjunction with unilateral malformations, involving structures other than the testicle or the cord. Hunter has reported fusion of the vesicles, the ducts of the two glands uniting and ending in a blind pouch. Multiple vesicles have been observed. Atrophy of the vesicles has been frequently noted at post-mortem examination and quite independent of any affection of the urethra or the testicles. Communication with the ureter also has been observed, this condition, which obtains during fœtal life, having persisted.

The ejaculatory ducts may be partially wanting, may be entirely absent, or may be fused; they may pass directly into the prostatic utricle, or may continue forward into a canal opening at some point on the glans penis, this condition giving rise to the misconception of a double urethra.

Injuries of the Seminal Vesicles.—From their position it is evident that the seminal vesicles are well protected against traumatism, except that which is so extensive that other lesions overshadow in importance the injuries to the vesicles.

In the event of the wounding of a vesicle in the performance of surgical operations on the bladder the consequences would not be serious. When both vasa or both ejaculatory ducts are divided or torn it is extremely probable that sterility will result from obliteration. A wound of the seminal vesicle alone is of minor importance, though it is conceivable that it might be followed by fistula. The treatment of wounds of the seminal vesicles is conducted in accordance with general principles.

Vesiculitis or Spermatocystitis.—The usual cause of this affection is extension of gonorrhœal inflammation into the congested seminal vesicles. It may be due also to infection with the ordinary pus microbes and perhaps with the colon bacillus. There is some proof of the possibility of its production by masturbation, excessive coitus, or direct extension from the bladder.

Symptoms.—The onset of acute seminal vesiculitis is characterized by practically the same symptoms as those noted in describing acute posterior urethritis. There are frequent, straining, painful micturition, and constant or shooting pains in the perineum, hypogastric region, and anus; the pain is often referred to the hip-joint and sacro-iliac articulation of the affected side, and runs down the outer side of the leg. Both direct and reflected pains are made worse by micturition or defecation. At times there are retention of urine and violent rectal tenesmus, the suffering being so intense that an opiate is required. Exceptionally the disease is ushered in with the fulminant symptoms of an acute peritonitis. There are vomiting, tympany, constipation, and tenderness over the whole lower belly-segment. Persistent erections are frequent; painful emissions of blood-stained semen are not uncommon.

Rectal examination shows at once a hot, tender, obscurely fluctuating mass passing upward and outward from the lateral lobe of the prostate, usually about the size of the thumb, with its upper limit beyond the region of the examining finger. According to the intensity of the inflammation and the amount of exudate this mass will be hard or soft. There is usually pronounced fever.

Sometimes acute vesiculitis develops insidiously. The patient is not confined to bed, but may complain of shooting intermittent pains of moderate severity in the perineum, with rheumatic aches felt in the hip, sacro-iliac joint, rectum, and perineum, or down the outer and inner surfaces of the leg.

Diagnosis.—The diagnosis of acute seminal vesiculitis is founded on rectal examination. When practicable this should be conducted with a fairly full bladder, the patient leaning forward over a chair, with the legs slightly separated; or he may be put in the lithotomy position and the base of the bladder outlined by bimanual palpation, the fingers of one hand being placed deeply behind the pubis, while the index of the other hand is introduced into the rectum. Palpation is the only means of making a differential diagnosis from prostatitis, and it must be noted that it does not enable the surgeon to distinguish definitely between spermato-cystitis and inflammation of the ampulla of the vas. In both cases the swelling, at least during the acute stage, is mainly due to infiltration of the intertubular and periglandular connective tissue. When both sides are involved this infiltration may be so extensive as to form a large projecting mass more prominent than the prostate and extending from the outer border of one vesicle to that of the other, completely masking the base of the bladder. This condition is often mistaken for acute prostatitis, but careful palpation will outline the prostate and show that it is normal in size. Usually the infiltration is not so extensive, the inflammation when bilateral forming two distinct masses. The pain referred to the hip-joint has seemed to us characteristic of involvement of the vesicles.

Seminal vesiculitis has been mistaken for appendicitis, and the symptoms may be identical. A history of urethral discharge would suggest a rectal examination which would clarify the diagnosis.

Prognosis.—So far as cure is concerned, the prognosis must be guarded. Suppuration once established in the convoluted tubule which makes up the bulk of this gland is difficult to cure, since its duct of entrance is so narrow that it is impossible to reach the diseased surfaces with any form of local medication. So far as recovery from immediate symptoms is concerned, the prognosis is extremely favorable, the disease usually undergoing partial spontaneous resolution whether treatment is adopted or not. There is, however, always a possibility of periglandular suppuration, with the formation of an abscess, which may rupture into the rectum, the bladder, or the peritoneal cavity. The inflammation frequently travels backward along the vas, causing epididymitis.

The usual termination of the affection is a chronic vesiculitis, which causes either no symptoms or those of urinary or genital irritability, and which has an ultimate tendency to recovery, though this may take months or years.

CHRONIC VESICULITIS.—This is the usual termination of acute inflammation. All the causes of pelvic engorgement predispose to its development; its indefinite prolongation is probably due to a strictured condition of the ejaculatory duct, which may be completely obliterated.

Symptoms.—The symptoms of chronic vesiculitis are practically those of chronic posterior urethritis,—*i.e.*, the patient is subject to irregular and apparently causeless attacks of frequent, urgent urination; he suffers from a gleet, which is also subject to exacerbations and remissions, or may light up after each intercourse; mild attacks of epididymitis develop occasionally; there is often alteration in the sexual power and appetite, and frequently there are developed pronounced symptoms of sexual neurasthenia, with pains referred to the back, hypogastrium, and thighs.

Diagnosis.—The diagnosis of chronic vesiculitis is founded upon rectal palpation and examination of the urine passed in three portions. The patient first urinates what he judges to be a third of the contents of the bladder; the seminal vesicles are then milked, and the patient again urinates, in two portions; the first portion passed after milking the vesicles will of course contain the major part of the fluid discharge from these glands.

Still another method of determining whether or not pus is discharged from the seminal vesicles is by irrigation of the bladder with a one-tenth per cent. solution of methyl-blue; this should be thoroughly washed out with boric acid solution, three or four ounces of which should be left in the bladder; the seminal vesicles are then milked, and the patient is directed to urinate; pus or shreds which are unstained will in this case come from the vesicles, the vasa, the prostatic follicles, or the ejaculatory ducts.

Treatment of Vesiculitis.—The prophylaxis of seminal vesiculitis consists in adopting every possible means of lessening the severity of posterior urethritis.

Acute inflammation of the seminal vesicles and of the ampullæ of the vasa should be subjected to the treatment applicable to the early stages of acute prostatitis. It is evident that a comparatively slight amount of inflammatory swelling and epithelial proliferation will entirely block the ejaculatory duct at or near its narrowest portion, the orifice, and there is reason to believe that the severity of vesiculitis is in part dependent on the degree of obstruction of the duct, since when this is closed there is no escape for the muco-purulent contents of the vesicle. Irritating injections or applications, the passage of instruments, or any manipulation which tends to aggravate the posterior urethritis should therefore be avoided, since this urethral inflammation necessarily increases the obstruction. During the acute stages of inflammation all urethral treatment should cease, with the exception of antiseptics administered by the mouth and the use of antiseptic unirritating irrigations. If these irrigations add to the severity of the symptoms they should be omitted.

Rest in bed, elevation of the pelvis, rectal injections of hot or cold saline solution, and hot sitz-baths or general baths are especially useful in lessening pain and congestion. Usually opium and belladonna suppositories are required.

Chronic vesiculitis is probably dependent upon narrowing of the ejaculatory duct and consequent imperfect drainage of the suppurating sac.

The treatment which is naturally suggested is dilatation of these ducts. They are, however, so small that even a filiform bougie cannot be introduced into them, and it is usually impossible to find them through a urethroscope. The natural course of a fine instrument introduced through the ejaculatory duct is towards the vesicle rather than towards the vas, and it may be possible in exceptional cases to use properly constructed instruments in such a manner that stricture will be cured.

Fuller's treatment by massage is most satisfactory in its results if it be applied gently, efficiently, and persistently. Each treatment expresses from the vesicles and the vasal dilatations the muco-purulent contents. The patient should have a full bladder. With his knees straight and his legs moderately separated he leans forward, bending the body almost to a right angle, and supporting himself by means of a chair or table. The operator having covered his examining index-finger with a well-lubricated thin rubber cover, passes it as far into the rectum as possible, thus reaching well above the base of the prostate and distinctly feeling the seminal vesicles if they be enlarged. By a stripping pressure from above downward, repeated on each side half a dozen times, the contents of the vesicles and vasa are forced through the ejaculatory ducts.

This treatment should be repeated twice a week, and should not be applied with sufficient force to cause immediate pain or secondary inflammatory reaction. It may have to be continued for many months, and must always be supplemented by the treatment appropriate to stricture or anterior or posterior urethritis when these conditions are also present. Posterior urethritis is practically always present when the seminal vesicles are inflamed.

Cystic Swelling of the Seminal Vesicles.—Usually as the result of obstruction of the ejaculatory ducts, conversion of the whole vesicle into a large single cyst or distention of one or more of its diverticula may occur; in the latter case the enlargement will be made up of a number of smaller cysts. This affection may run its course without exhibiting symptoms other than those incident to chronic inflammation until the tumor reaches sufficient size to produce pressure effects. Cases are reported in which the cyst reached enormous dimensions. In one case quoted by Jacobson ten pints of brown serous fluid were drawn off. After two tappings the cyst did not refill.

The diagnosis is based on rectal palpation. This condition can scarcely be differentiated from dermoid cysts, or cysts due to the rapid development of the remains of fœtal structures.

Treatment.—The treatment in such cases is aspiration, which may be twice repeated. In case this fails, permanent drainage may be established through a perineal opening, or the cyst may be excised through Zuckerkandl's, Von Dittel's, or Kraske's incision. (See page 719.)

Spermatocystic Concretions.—These concretions are probably formed originally because of obstruction of the duct. They are made up of spermatozoa, mucus, and epithelium, and are whitish in color, becoming darker with age and undergoing calcification. Their importance lies in the fact that they may occlude the ejaculatory duct, thus predisposing to sterility and rendering the cure of vesiculitis impossible. The symptoms are pain on emission, associated perhaps with the symptoms of posterior urethritis, such as frequent urination and tenesmus.

The diagnosis will be made on rectal examination, which may demonstrate one or more hard bodies in the seminal vesicles.

Treatment consists in breaking up these concretions by pressure through the rectum exerted against a full-sized sound passed into the urethra.

Tuberculosis of the Seminal Vesicles.—Tubercular vesiculitis is nearly always secondary to involvement of the prostate and the prostatic urethra or the epididymis, though clinically cases are sometimes observed in which distinct nodulation of the vesicle can be felt, the prostate being apparently healthy, and symptoms pointing to involvement of the prostatic urethra being absent.

Tubercular vesiculitis is characterized by the formation of a smooth, nodular, hard or semi-fluctuating tumor, easily detected on rectal palpation. Both seminal vesicles are often involved, and the fibrous tissue lying between them is infiltrated, forming a mass practically continuous with the prostate and entirely obscuring the base of the bladder, which normally can be felt. The infiltrated mass is rarely sensitive, and in the absence of involvement of the prostatic urethra causes few symptoms, except possibly sexual erethism, bloody semen, pain during or after ejaculation, and finally sterility and impotence. The infiltrate often breaks down, discharging into the rectum and perineum.

Tubercular vesiculitis is essentially an affection of the adult, and is usually associated with involvement of the prostate and epididymis. The invasion of these structures is often simultaneous. Clinically, we have many times noted tubercular vesiculitis precede by weeks or months palpable lesions of the epididymis. As a rule, when a tubercular epididymitis becomes demonstrable, the vesicle of the affected side is palpably involved.

Diagnosis.—The diagnosis of tubercular vesiculitis is founded upon the discovery of an irregular, nodulated, non-sensitive growth occupying the position of the seminal vesicle, and associated with other symptoms or signs of genito-urinary tuberculosis, such as nodulation of the epididymis, frequent urination, with passage of blood and the finding of tubercle bacilli in the urine or the semen. The ejaculation of bloody semen in the absence of other cause, such as gonorrhœal spermato-cystitis, is especially characteristic.

Tubercular vesiculitis occurring in the course of gonorrhœal posterior urethritis can be recognized only by the gradual development of a nodular semi-fluctuating tumor. The termination is usually in suppuration and the formation of fistulous tracts. Spontaneous cure has been reported following evacuation of abscesses.

Treatment.—In the absence of symptoms, and when nodulation of the epididymis is non-progressive, treatment may be confined to the general hygienic, dietetic, and medicinal measures applicable to general tuberculosis. As in all inflammations or infiltrations of the pelvic viscera, regular evacuations from the bowels are of extreme importance, and as a means of lessening local congestion the urine should be rendered unirritating and should be passed at regular intervals. If in spite of careful treatment inflammation is steadily extending, excision of the infiltrated vesicle is indicated, even though experience has shown that a few of these cases after discharging undergo resolution.

The operation of excision is neither difficult nor especially dangerous. The objection to it is that the prostate is commonly involved, that the bladder-walls are frequently infiltrated, and that complete removal may be followed by fistula formation.

Excision may be accomplished through Kraske's incision for excision of the rectum, the bowel being carried to one side after partial excision of the sacrum, or through Zuckerkandl or Von Dittel's incision The first consists in a semilunar cut extending from one tuber ischium to the other and sweeping convexly in front of the rectum. The perineal muscles and the pubic portion of the levator ani muscles are divided, exposing the prostate and the seminal vesicles. Von Dittel, after passing a catheter into the bladder and filling the rectum with gauze, to which a string is attached, places the patient in the ventral decubitus, with the thighs hanging over the end of the table. The incision is then made, beginning at the coccyx and carried directly in the middle line to the middle of the perineum, making a semicircular sweep around the anus. This cut is deepened, the rectum being pushed aside until the seminal vesicles are reached. It must be remembered that the latter are enclosed in a tough, fibromuscular investment, usually covered by greatly enlarged veins. This capsule must be split before the vesicles can be enucleated. After thorough removal and curetting, the cavity should be packed with iodoform gauze. When operation cannot be undertaken, injections of a ten per cent. emulsion of iodoform in glycerin may be driven directly into the infiltrate through the bowel by means of a long needle.

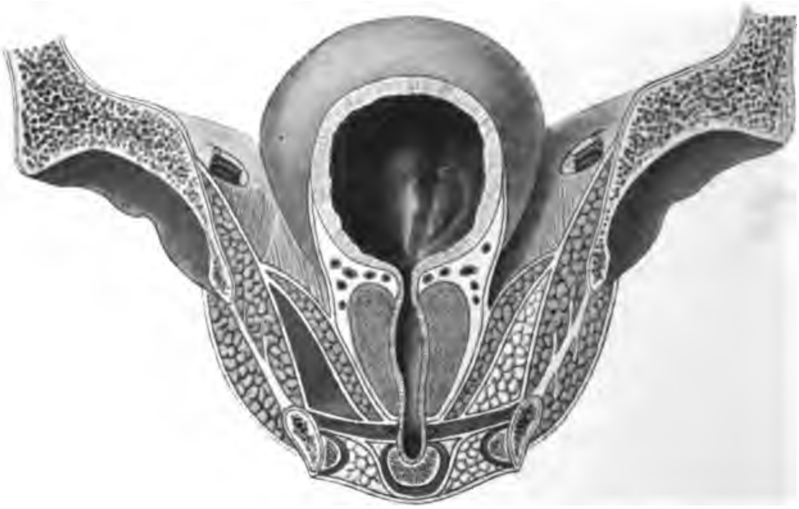
Malignant growth of the seminal vesicle is always secondary to malignant growth of the adjoining organs.

CHAPTER XX.

INJURIES AND DISEASES OF THE PROSTATE.

Anatomy of the Prostate.—The prostate is a genital organ, the bulk of which is made up of glandular tissue and smooth muscular fibres. As is the case with all genital organs, it varies greatly in size; in children it is rudimental. At the age of puberty it grows rapidly, but does not attain its full development until about the twenty-fifth year; at about the fiftieth year there is a further increase of size. On an average the normal adult prostate is about one and a half inches wide at its base and one to one and a quarter inches long and three-quarters of an inch thick. It weighs about five drachms. Its fibrous muscular capsule is intimately connected with the gland substance; its outer surface can be stripped from the prostatic sheath with comparative ease. The stroma is composed of smooth muscle fibres and connective-tissue elements. Bands of muscle and connective tissue pass from the capsule into the substance of the gland, sepa-

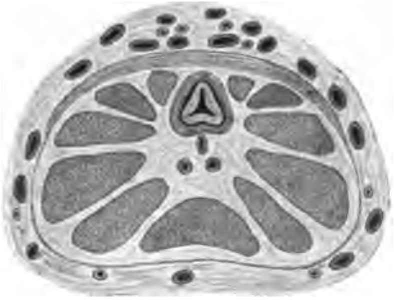
FIG. 223.



Vertical section of pelvis showing the bladder, prostate with its surrounding plexus, and supporting structures of the perineum. (Testut.)

rating the lobules and giving each a distinct investment. The gland is made up of from forty to sixty of these lobules. (Fig. 224.) The relative proportion of the glandular elements to the stroma varies greatly. In shape it somewhat resembles a Spanish chestnut, though this is subject to many variations. It may be thin or thick, wide or narrow, short or long, symmetrical or irregularly developed. To the examining finger it is often cordate, presenting a central notch at its base. The prostate is made up of two lateral lobes connected by an isthmus, which, from its thickness and from the fact that it sometimes forms a distinct projection, has been called the third lobe. This isthmus lies just below the vesical orifice of the urethra and above and behind the ejaculatory ducts, discharging its secretion into that portion of the urethra which lies nearest the bladder. The prostate is placed behind and slightly below the symphysis pubis, lying between the posterior layer of the triangular ligament and the neck of the bladder, which is surrounded by its base. The under or posterior surface often presents a central furrow dividing the organ into two distinct lobes. This surface is in intimate relation with the rectum, from which it is separated by the thin recto-vesical fascia and by the prostatic sheath. The latter completely invests the gland, forming a tough connective-tissue covering in which are found the large veins of the prostatic plexus. (Figs. 223, 224.) Its most intimate connection with the prostate is at the neck of the bladder, the prostatic veins passing from the gland at this point to join the fascial plexus. The anterior surface faces towards the pubis, from which it is separated by the plexus of Santorini and the pubo-prostatic ligaments. The lateral surfaces are in relation with the levator ani muscles, to which they are attached by fibro-muscular fascia; the vesico-prostatic plexus of veins is found in this region. The base of the prostate embraces the neck of the bladder, but is entirely distinct from it.

Fig. 224.

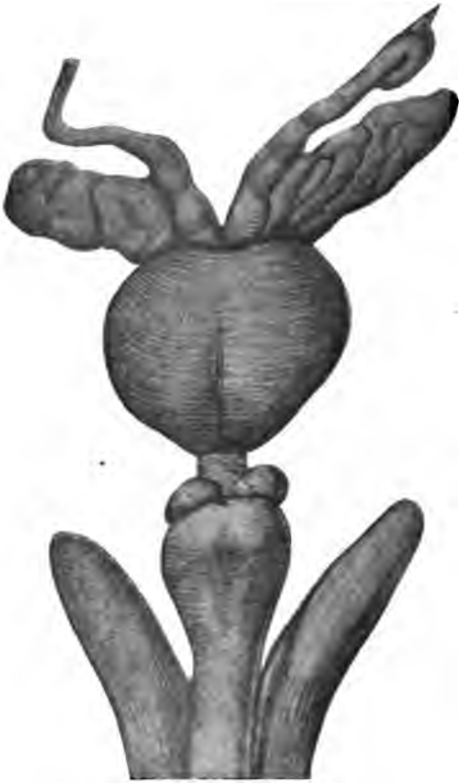


Plexus of vessels surrounding the prostate within the meshes of the false capsule. (Testut.)

Between the lateral lobes and above the commissure or posterior lobe passes the prostatic urethra practically surrounded by the prostate, though with the greater bulk of this organ below and behind. The utriculus, a structure entirely distinct from the prostate, lies in this mid-portion, as do the ejaculatory ducts.

The muscular and glandular connections between the normal prostatic lobes and the urethra are so intimate that it is impossible to remove the former by avulsion or blunt dissection without extensive laceration or destruction of the former.

FIG. 225.



Ejaculatory ducts, seminal vesicles, prostate, membranous urethra, Cowper's glands, bulbous urethra, corpora cavernosa. (Murphy.)

More than three-fourths of the bulk of the latter is made up of smooth muscular fibres. These enclose the ducts and acini of many compound racemose glands. In these acini, after the age of puberty, are frequently found albuminoid sympexes. The greater number of the excretory ducts open upon the floor of the prostatic sinus, passing somewhat obliquely. Some open into the sides or the roof of the canal, and some into the prostatic utricle. These glands are most numerous in the posterior lower portion of the isthmus (middle lobe).

The blood-supply of the prostate is derived from the internal pudic, vesical, and hemorrhoidal arteries. The veins are particularly numerous, and form a rich plexus about the sides, base, and anterior surface of the gland. The nerves are from the pudic and the hypogastric plexus.

CONTUSIONS AND WOUNDS OF THE PROSTATE.

Contusion of the prostate is probably a commoner accident than is generally supposed. It may be caused by kicks or blows in the posterior perineum, or by jars such as may be received in horseback or bicycle riding. The symptoms are those of acute prostatic congestion,—*i.e.*, deep-seated pain, tenesmus, moderate ardor urinæ, frequency and urgency of urination, and sometimes a sense of rectal fulness. These symptoms subside in a few hours or a few days, and, unless there has been a preceding latent lesion, are unattended by sequelæ.

The pathological alterations which take place from comparatively slight contusions are unknown, since they never result fatally. It is possible that in the severer forms there are slight multiple parenchymatous hemorrhages.

Wounds of the prostate, except those inflicted during the course of a surgical operation, are of minor importance, since this gland is so placed that the vulnerating body which reaches it almost necessarily involves other and more important structures. Incision into the prostate practised during the course of surgical operations is unattended by danger, unless the rich plexus of veins placed at the borders of this gland and above it is also involved. The hemorrhage then may be serious or even fatal. From the prostate itself bleeding is usually moderate, or, if severe, is readily controlled by packing.

Should infection occur, wounds of the prostate may be extremely dangerous, since septic phlebitis may result, rapidly extending along the large, freely anastomosing pelvic veins, and causing septicæmia or pyæmia. If suppuration takes place in the coats of the veins, they may undergo fatty metamorphosis and break down, causing serious hemorrhage.

Prostatic wounds involving the urethra are subject to the dangers of internal hemorrhage and urinary infiltration. The blood may flow backward into the bladder, filling it with a thick, clotted mass, which may be extremely difficult to dislodge. If the bleeding is profuse, a hard, globular tumor may form above the pubis.

Prognosis.—Wounds of the prostate, particularly those which do not involve the urethra, heal promptly, provided they are kept clean. When the urethra is opened there is little danger of urinary extravasation if abundant provision is made for drainage. These wounds generally heal kindly, and are seldom followed by urinary fistula or interference with micturition; exceptionally the formation of a prostatic cicatrix interferes with the action of the vesical sphincter and causes a more or less permanent condition of incontinence.

When the prostate is extensively injured and the capsular investment widely torn, dangerous complications, such as pelvic cellulitis and even peritonitis, may follow. The lacerated and contused wounds caused by forced catheterization, as a rule, heal kindly, provided the urine is not infected. If this fluid is septic and if the prostate is already infected, abscess-formation, phlebitis, and infiltration, ending in septicæmia and death, are common.

Treatment.—A wound of the prostate not involving the urethra should be cleansed and packed with sterile gauze. If in the course of twenty-four hours urination becomes difficult, consequent upon inflammatory action, a permanent catheter should be worn for two or three days, in the manner described when treating of retention of urine from enlarged prostate. If the prostatic urethra or the vesical neck has been opened, a soft catheter should be passed through the urethra into the bladder, and retained there for several days, and the perineal wound should be cleansed and packed. If it is impossible to introduce an instrument into the bladder, median perineal urethrotomy should be performed, and a large, soft drainage-tube should be carried through this opening into the bladder and retained there. If there is bleeding, the catheter *en chemise* should be introduced.

When the wound has been caused by forced catheterization and the bladder is full of blood, this should be withdrawn by suction through a large woven or metal catheter, or through the evacuating-tube used in litholapaxy, if this instrument can be introduced. A full-sized catheter is then passed into the bladder and is retained for several days, the bladder and urethra being flushed out several times daily with a mild antiseptic solution.

Should symptoms of local abscess or septic infection develop, the prostate should be opened by median perineal urethrotomy and thorough drainage secured through this opening. If after wounding the prostate by forced catheterization no instrument can be introduced into the bladder, median cystotomy should be performed. When hemorrhage into the bladder is unattended with symptoms of distention or local inflammation, surgical intervention may be delayed, provided the urine is sterile and the urethral instrumentation has been practised with proper antiseptic precautions. There is, however, always a risk of bacterial infection: hence it is wiser to disintegrate the clots by vesical irrigation and at the same time keep them sterile by using antiseptic solutions. The Thiersch solution will usually suffice. Urinary antiseptics should at the same time be given by the mouth.

PROSTATITIS.

Inflammation of the prostate may be acute or chronic; it has also been classed as follicular,—*i.e.*, confined to the glands and periglandular tissue,—or parenchymatous, attacking the entire organ.

Causes.—The immediate cause of prostatitis is infection. It is true that inflammatory reaction invariably follows traumatism, but in the absence of infection this undergoes prompt resolution. Infection may be conveyed along the urethra, as in the case of gonorrhœa; may be either hæmatogenous or carried by the urine, as in prostatitis which complicates small-pox, scarlet fever, typhus, typhoid, and other infectious diseases; or may reach the prostate by contiguity of structure, as from periprostatic suppuration.

Congestion is a condition which strongly predisposes to infection, and which is apparently essential to its development. Congestion may be due to traumatism, as from instrumentation or jarring of the perineum, excessive venery, constipation, masturbation, prolonged ungratified sexual excitement, hemorrhoids, irritating applications, strongly acid or alkaline conditions of the urine, urethral calculi, varicose condition of the prostatic plexus, over-distention of the bladder, atheromatous vessels, chilling, over-fatigue, and a variety of other causes.

The common causes of acute prostatitis are the backward extension of gonorrhœal urethritis and the introduction of unclean instruments. The bicycle has been arraigned as a frequent exciter of prostatic inflammation. Careful investigation convinces us that bicycling does not predispose to diseases of the prostate or otherwise injuriously affect the gland, especially if a correct attitude be maintained. Every surgeon sees cases of transitory prostatic irritation, nearly always due to the use of a saddle which presses on the perineum. There are some patients with sensitive prostates in whom the jarring inseparable from riding always produces an aggravation of symptoms. These are, however, few, and the great majority of such patients experience distinct relief, due probably in the main to the beneficial effects of exercise, yet doubtless in part to direct stimulation of the prostatic circulation. With a proper seat which supports the weight on the tuberosities of the ischium when the patient assumes the correct position, we believe that bicycle riding is entirely unobjectionable so far as the prostate is concerned.

Pathology.—Acute prostatitis is characterized by marked dilatation of the prostatic plexus of veins and increased vascularity through the entire gland; the inflammation, usually beginning in the mucous membrane of the urethra, extends primarily along the ducts of the glands, and secondarily, when these have become obstructed, forming suppurating retention cysts, through the parenchyma of the organ. Abscesses may appear in the form of small multiple foci or as large collections. The small foci represent the glands transformed to sacs containing mucus, epithelium, and pus, the ducts being partially or completely obstructed. As the inflammatory secretion increases in quantity the glandular capsule may rupture, several of the suppurating glands becoming confluent, forming large accumulations. The ejaculatory ducts are always involved in the general catarrhal inflammation, and frequently become occluded from inflammatory swelling and epithelial proliferation. There results tension in the seminal vesicles and the ampullæ of the vas. This increases congestion, and thus strongly predisposes to further extension of inflammation. The prostatic utricle is also involved.

Exceptionally inflammation extends beyond the proper capsule of the gland, involving the tissues lying between the prostate and the rectum, or even the subperitoneal connective tissue. This periprostatitis may be due to rupture of the pus through the glandular capsule, or to transmission of infection through the medium of the veins and lymphatics. The infiltration may undergo resolution or may suppurate; suppuration is commonly encountered on the posterior surface of the gland,—*i.e.*, between it and the rectum. It may form an abscess completely surrounding the vasa deferentia and the seminal vesicles without exhibiting any tendency to rupture into them.

From this brief outline of the pathology of the inflammation it is evident that prostatitis may be manifested in the form of acute hyperæmia and swelling, usually secondary to acute catarrh of the prostatic urethra; in that of acute folliculitis, the inflammation involving not only the prostatic urethra, but also the prostatic ducts and their accompanying glands, and transforming them into sacs filled with mucopus; in that of a large destructive abscess due to fusion of the smaller suppurating foci; or in that of a periprostatitis.

Symptoms.—The symptoms of prostatitis vary in accordance with the form and severity of the attack. In the mildest form, characterized by acute congestion, there are feelings of weight in the perineum, shooting pains, frequency of urination, and possibly difficulty in starting the stream and failure to experience complete relief after the bladder is apparently empty, pain on defecation, and tenderness and enlargement. When inflammation is more pronounced, involving the glands and their ducts, the symptoms already noted are increased in severity; there is often the sensation as though a foreign body were stuffed in the rectum; urination is frequent and urgent; a small stream is passed without force, and often intermittently, and the pain is severe. When there is an abscess-formation in or about the gland both local and general symptoms are usually pronounced. There is constant pain in the perineum, aggravated by urination, defecation, or motion of any kind; sitting down or crossing the legs is particularly painful. There is a constant, urgent, wearing desire to urinate, each act of micturition voiding a small forceless stream. Defecation may cause great anguish. Intermittent urethral discharge is characteristic. Painful erections are frequently observed. Rigors or chills, followed by fever and headache, are nearly constant. As the swelling becomes greater, urination is correspondingly more difficult, until finally complete retention may result. Hemorrhoids often develop, caused by pelvic congestion, or possibly by the constant straining efforts at urination which prostatitis often occasions.

Diagnosis.—The diagnosis of acute prostatitis is founded on the detection by rectal palpation of a hot, tender tumor occupying the position of the prostate. This, in conjunction with some or all of the above symptoms, and especially with fever and with pain which is especially severe during defecation and at the end of urination, is sufficient to establish the diagnosis.

Prognosis.—The prognosis of acute prostatic congestion, in the absence of infection, is extremely favorable; even when there has been infection, provided the urethra is free from abnormal narrowing and there is no local or general cause for chronic congestion, recovery is the rule. When follicular or parenchymatous suppuration has taken place, the prognosis is still favorable, although there is always danger of septic phlebitis. The glandular abscesses commonly rupture into the urethra, and this is considered a favorable termination. So far as relief of immediate symptoms is concerned, this is undoubtedly correct; but when the abscesses are of considerable size this termination is less favorable, since there is often left a pouch or cavity which will continue to suppurate indefinitely, thus maintaining a condition of chronic prostatitis, and in which the urine is lodged, deposting calculi, which ultimately burrow through the prostate and cause uro-purulent infiltrations of the surrounding tissues or fistulæ.

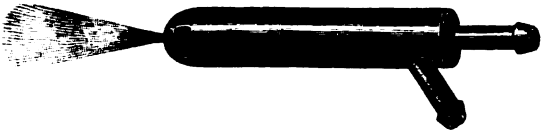
Acute parenchymatous prostatitis characterized by rapid, purulent breaking down of the entire gland may result fatally. About half these cases rupture into the urethra.

The ordinary directions of pointing are towards the urethra, the rectum, and the perineum. The pus may exceptionally point in the inguinal or the obturator region; with extreme rarity in the space of Retzius, in the peritoneal cavity, or through the sciatic foramen. The opening of such abscesses into the recto-vesical space is usually attended with the formation of multiple fistulæ, which are difficult to cure. Ransohoff notes that of sixty-seven cases twenty-one opened into both the rectum and the urethra. The resultant fistula may be beyond relief.

Segond calls attention to the frequency of phlebitis when prostatic abscess is not properly drained. About forty per cent. of the deaths are due to this cause. He reports the total mortality as thirty-four in one hundred and fourteen cases. This is extraordinary, and is not to be accepted as the usual result.

Treatment.—The treatment of acute prostatitis consists in rest in bed, elevation of the pelvis, counter-irritation or local depletion by the application of counter-irritants or leeches to the perineum, followed by hot fomentations, hot or cold rectal douches, or ice-bags, the use of opium and belladonna suppositories, the internal administration of urinary antiseptics and bromides, and the ingestion of large quantities of water. The diet should consist principally of milk. Hot hip-baths or hot general baths markedly diminish the pain and tenesmus, and may be administered several times a day, the patient being subsequently well wrapped up. The temperature of the water should be at least 105° F. In the beginning of the attack the bowels should be freely opened by salines. After this there should be no effort to procure evacuation for several days, unless there is reason to believe that the rectum is filled with fæcal matter.

FIG. 226.



Rectal irrigator.

The most troublesome complication is retention of urine. This is overcome by the introduction of a soft catheter. When this is especially difficult or painful there should be given an anæsthetic, and an instrument having once been introduced should be left in place until the acute symptoms have subsided.

When an abscess opens into the urethra spontaneously or as the result of catheterization, on the subsidence of acute symptoms every effort should be made to cause cicatrization of the cavity. If this is small, spontaneous healing often takes place. If it is large, suppuration continues, kept up in a measure by the urine, which, lying in this sac, decomposes, becomes irritating, and often deposits calculi. The tendency of this ulcerating sac is towards gradual extension, destroying the proper capsule of the prostate and causing either extravasation of urine or periprostatic abscess. Obstinate fistulæ are likely to form as the ultimate result of these untreated abscess-cavities.

As soon as the acute inflammatory symptoms have subsided, the suppurating cavity should be washed out twice daily. This is accomplished as follows. By means of a finger introduced into the rectum the prostate is well milked and the abscess emptied of its pus. The patient is then directed to urinate, and the urethra and bladder are irrigated with a mild antiseptic solution; boric acid or silver nitrate answers well. The prostate is again milked, and the patient evacuates that portion of the irrigating fluid which has entered the bladder. This is repeated two or three times at each treatment.

When there is no tendency towards the spontaneous evacuation of the abscess through the urethra, and the chills, fever, and throbbing pain in the perineum persist, and there is marked increase in the swelling, the pus should be evacuated by perineal incision. There should be no hesitation under these circumstances in performing the operation, since, unless the abscess ruptures into the urethra, it is liable to burst through the capsule of the gland, infiltrate the deep pelvic tissues, and not infrequently cause pyæmia and death. The operation should be conducted under an anæsthetic, the prostate being exposed by a semilunar incision in front of the rectum, deepened by gradual dissection. The focus of suppuration may then be detected by the exploring needle. When the tumor is obviously fluctuating it may be opened by a long, straight bistoury thrust in the middle line of the perineum directly in front of the rectum, with its back towards this structure and guided towards the abscess by a finger introduced through the anus. After opening the abscess the cavity should be flushed out, and should be drained either by gauze packing or by tubes. Urethral fistula occasionally follows, but usually closes spontaneously.

The treatment of periprostatitis and periprostatic abscess is the same as that described as applicable to prostatitis. The pus is apt to point in the posterior or anal perineum and to invade the ischio-rectal space, inasmuch as its origin is behind the middle perineal fascia.

Chronic Prostatitis.—Following an acute attack of prostatitis, or secondary to posterior urethritis or cystitis without a history of an acute attack, the prostate may become chronically inflamed. The exciting cause is infection, the predisposing cause congestion. This congestion may be due to long-continued ungratified excitement, excessive coitus, masturbation, hemorrhoids, habitual constipation, irritating conditions of the urine, or any of the conditions which have already been mentioned as causing pelvic engorgement.

The pathology of the affection varies. There is practically always chronic posterior urethritis. Associated with this there may be a catarrhal condition of the prostatic glands, attended by distinct dilatation of their ducts and acini and marked thickening of the periglandular tissue.

There may be one or many abscesses discharging into the prostatic urethra through openings insufficient for thorough drainage. These are attended by general engorgement, and ultimately result in the development of fistulæ, or in cicatricial deformity or atrophy of the prostate.

Symptoms.—The symptoms of chronic prostatitis may be slight or severe. Usually there is increased frequency in urination, deep perineal pain which radiates to the rectum, scrotum, and down the thighs and is made worse by exertion, slight tenderness in the perineum, thickening and sometimes irregular nodulation of the prostate. After urination and during defecation there is a viscid milky discharge, containing pus, columnar epithelium, and amyloid prostatic bodies. The pain is often severe at the end of urination, and may be felt either in the deep perineum or in the urethra, a quarter of an inch behind the meatus. It is burning in character. After defecation there may be severe burning perineal pain, lasting a few minutes or for several hours. There are frequent intercurrent subacute attacks of inflammation, and these patients very commonly suffer from headaches or muscular and joint pains similar to those due to toxæmia from other causes. There are often loss of sexual desire, great weakening of sexual power, and frequent pollutions. On rectal examination the prostate may be unduly sensitive at some portion of its surface. It may or may not be enlarged, and sometimes is distinctly bossed or asymmetrical. The urine passed after milking this organ contains a considerable quantity of pus. The introduction of an instrument into the prostatic urethra gives more pain than is normal, and its point may become engaged in an abscess-cavity. The most pronounced symptom in these cases is the profound alteration of disposition. These patients become melancholic, neurasthenic, and invalided.

Albarran describes a proliferating prostatitis observed in both the young and the old, characterized by the symptoms of moderate prostatic urinary obstruction and the presence of a moderately sized smooth, or slightly nodular, fairly firm, or soft prostate, which may be sensitive to pressure.

Prognosis.—In chronic prostatitis the lesions of which are mainly congestive, with follicular catarrh not yet having developed to distinct abscess-formation, there is a tendency towards spontaneous cure. Small abscess-cavities also heal. The larger sacs show no such tendency. They are rather inclined slowly to extend, causing periprostatic abscess and urethro-rectal or urethro-perineal fistulæ, often complicated by calculi. In cases characterized by symptoms so sligh as to excite no attention, the condition may remain latent, though slowly progressive for years, causing ultimately the atrophied prostate and sclerosed and contracted internal vesical sphincter which induce the most inveterate forms of prostatism.

Treatment.—On beginning the treatment of chronic prostatitis the patient should be informed that cure is slow and difficult and is dependent upon persistence in the use of appropriate therapeutic measures and faithful observance of the laws of health. General directions are given in regard to diet, exercise, and hours of sleep. The urine is rendered bland and slightly antiseptic. The bowels are properly regulated by enemata; erotic excitement is avoided. Ordinary sexual intercourse need not be forbidden. It is undoubtedly true that many cases of chronic prostatitis would be cured by hygiene alone if it included regular and unemotional sexual gratification. Unfortunately, the majority of these patients are young, unmarried adults, and, even if the question of morals were set aside, it would not be possible for them to secure sexual relations that would meet their requirements. Hip-baths of a temperature and duration governed by the sensations of the patient are useful. Rectal lavage with hot or cold normal saline solution should be used daily. The use of the cold jet by means of the bidet is markedly beneficial in many cases.

Massage followed by urethral irrigations, as described in the treatment of seminal vesiculitis, is serviceable, even when pus-collections are not present, since this treatment expresses the contents of the prostatic glands and enables the cleansing, slightly stimulating fluid used for irrigation to act directly upon the diseased and congested mucous membrane. In a chronic prostatitis kept up by pus-cavities massage is of special importance.

Local applications to the prostatic urethra are generally indicated for the relief of the accompanying posterior urethritis. These are selected and applied in accordance with the principles already laid down, but should be used cautiously, since reactionary swelling may entirely close the urethral opening of a chronic abscess, causing retention of pus, extension of parenchymatous inflammation, and septic absorption. If the reaction following the use of weak instillations is unusually prolonged and severe they should be discontinued.

The treatment of urinary retention, with its painful complications and fatal sequelæ dependent on sclerosis of the internal vesical sphincter secondary to chronic prostatitis, requires over-dilatation or section of the obstructing ring. Prostatectomy, though often performed for the relief of this condition, is not indicated.

Irritable Prostate.—This is a condition characterized by repeated rather sudden and acute engorgements of the prostate, usually dependent upon an abnormal condition of the urine, such as excessive acidity. It is also due to chilling and other well-known causes of pelvic congestion. It is probable that it does not attack the perfectly healthy prostate. It has been so often observed in gouty patients that the manifestations of this form of irritability are in them called prostatic gout.

The symptoms are those of the first stage of acute prostatitis. There develops often in the night urgent, frequent, painful urination. There may be steady or shooting pain felt in the perineum, testicles, or back. On rectal examination the prostate is hypersensitive. In gouty patients the urine is extremely acid and contains an excess of mucus. The symptoms attain their maximum severity during the night, and the prostate remains sensitive for some time. This condition of irritability may be the first step in the development of cystitis or calculus-formation.

Diagnosis.—An irritable prostate is distinguished from an inflamed gland by rectal palpation and examination of the urine. Inflammation is always accompanied by the formation of pus and by marked increase in the size of the prostate. The diagnosis of prostatic gout depends upon the constitutional history of the patient and examination of the urine.

Treatment.—The irritable prostate is amenable to treatment directed to the relief of congestion. Acid or irritating conditions of the urine should be remedied, sexual excess, constipation, and the well-recognized causes of pelvic congestion should be avoided, and the prostatic circulation should be strengthened by massage, hot rectal injections, and the application of electricity. In general the treatment applicable to the early stages of acute prostatitis is serviceable for the relief of acute attacks. The medicinal treatment is directed to the equalization of circulation and the general strengthening of the patient. Hyoscyamine and ergotine seem to have some value by their direct action on local circulation, and may be given in the form of suppository.

TUBERCULOSIS OF THE PROSTATE.

The prostate is nearly always affected in genito-urinary tuberculosis, Krzywicki noting that of fifteen cases the gland showed lesions in fourteen. Tuberculosis may be primarily in the prostate or secondary to involvement of organs either adjacent or remote. The proportion of cases in which the disease is primary in the prostate is not known, since there have been few opportunities offered for postmortem examination until tuberculosis has been widely diffused.

There have, however, been a sufficient number to prove that the first manifestation of the disease may appear in the prostate gland. This gland is particularly susceptible to infection of all kinds, Weigert having proved that it is involved in the majority of cases of pyæmia and septicæmia. Tubercle bacilli have been found in the apparently healthy prostate.

Tubercular prostatitis is commonest in the prime of life. It is often excited by posterior urethritis; at least the histories of many of these cases show that tubercular involvement followed gonorrhœa. It is evident that any of the causes of prostatic congestion may thus predispose to the local development of tuberculosis. The morbid anatomy of tubercular prostatitis is that characteristic of tubercular involvement in general,—*i.e.*, exuberant granulation, central degeneration, and caseation. The tubercles are first lodged in the walls of the glandular ducts, extending through a part or the whole of the gland, and ultimately either undergoing encapsulation or absorption, a rare termination, or softening and breaking down, forming abscess-cavities.

The prostate is usually enlarged from inflammatory congestion; abscess-formation takes place slowly but surely. Exceptionally the lesions develop in the lower outer portion of the gland near the rectum; usually they are observed near the urethra. In this case ulcers are formed which steadily extend. Abscesses developing in the substance of the gland, though occasionally sclerosing and healing, commonly enlarge steadily, opening into the urethra, the rectum, the perineum, or even the hypogastrium, and forming multiple fistulous tracts. Tuberculosis of the prostate becomes generalized slowly.

Symptoms.—The symptoms of tubercular infiltration of the prostate are practically those of chronic prostatitis, and are probably dependent upon involvement, or at least secondary congestion, of the prostatic urethra. The patient complains of frequent, often urgent, urination, and a slight continuous or intermittent, glairy, muco-purulent discharge from the meatus. Shreds are constant in the urine; there may be a discharge after defecation or even after each act of urination; sometimes one or two drops of blood are passed at the end of urination, and attacks of acute or subacute prostatitis are excited by slight and apparently insufficient causes. When the parenchymatous or peripheral portion of the gland is involved there may be no symptoms for a long time, or the patient may note slight pain during defecation and burning pain afterwards. In certain cases the disease appears to begin as an acute parenchymatous prostatitis. On the subsidence of the early inflammatory symptoms nodulation may be felt.

Diagnosis.—This is based on finding the tubercle bacilli in the discharge milked from the prostate and subsequently voided with the urine, on the detection of thickening, nodulation, or points of softening on rectal examination, and on the discovery of tubercular involvement of the epididymis or the seminal vesicles. The infiltration sometimes spreads wide of the prostate, forming a large, irregular, diffuse mass entirely obscuring the outlines of the prostate and vesicles.

Prognosis.—This is extremely grave. Spontaneous cure by a process of sclerosis, though possible, is rare.

Treatment.—The treatment should be directed towards improving the general health of the patient, and is practically that appropriate to pulmonary consumption. As a rule, local instrumentation and applications should be avoided, with the exception of instillations of mercuric bichloride (1 to 6000). These may be employed as directed in the treatment of tubercular cystitis, and are serviceable only when the infiltration begins in the urethra or in the ducts of the glands. Silver nitrate causes pronounced and prolonged exacerbation of suffering.

In conducting local treatment it must be remembered that tubercular infiltration especially predisposes the involved portions of the prostate, and the bladder, which also often shows tubercular lesions, to the invasion of the ordinary pus micro-organisms: hence special antiseptic precautions should be taken in the use of instruments.

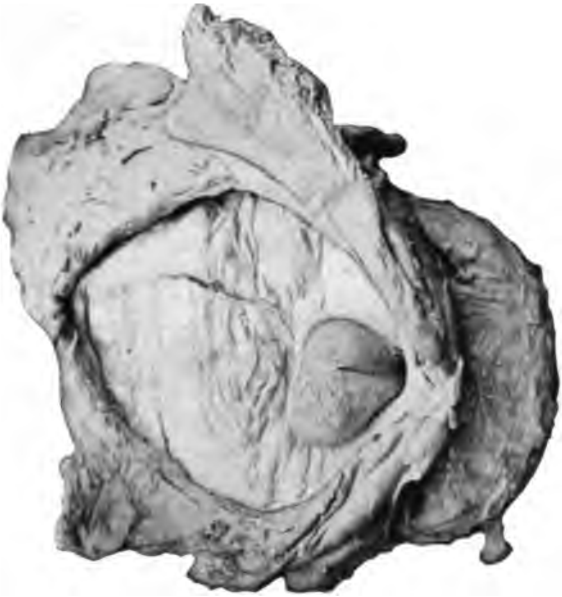
Direct operative treatment is indicated when the general condition of the patient is fairly satisfactory and it is evident that the disease is steadily progressing.

Incision is indicated when an abscess develops which threatens to form a fistula. The prostate should be fully exposed by the semilunar incision in front of the anus, and all the diseased tissue should be removed by the curette, the urethra not being opened if it is possible to avoid this. The wound is treated by packing with iodoform gauze. Abscesses opening into the urethra are kept clean by irrigation. Retention of urine is relieved by continuous catheterization or suprapubic drainage.

ENLARGEMENT OF THE PROSTATE.

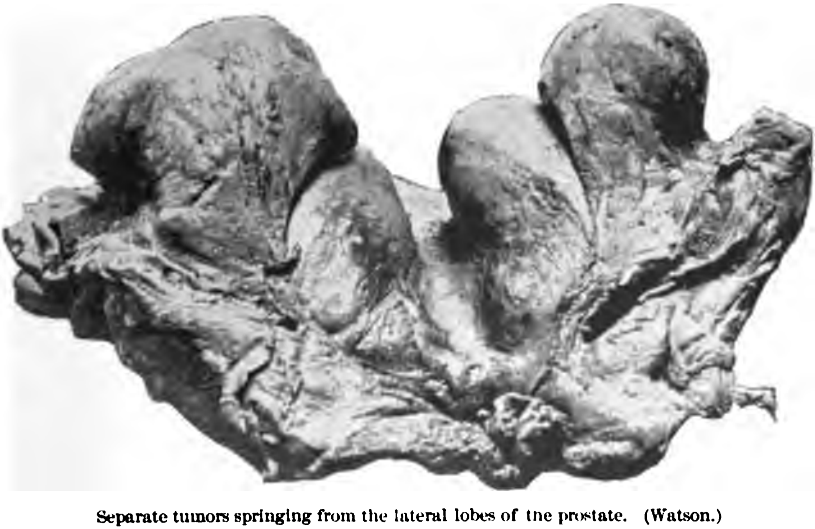
Enlargement or hypertrophy of the prostate consists in an overgrowth of the normal cellular constituents of the gland taking place in the lobes or the isthmus or affecting the entire organ. At the beginning of the overgrowth the change in form is best expressed by what Thompson calls an unnatural tendency to rotundity. The gland is increased in thickness rather than in other dimensions, the lateral

Fig. 227.



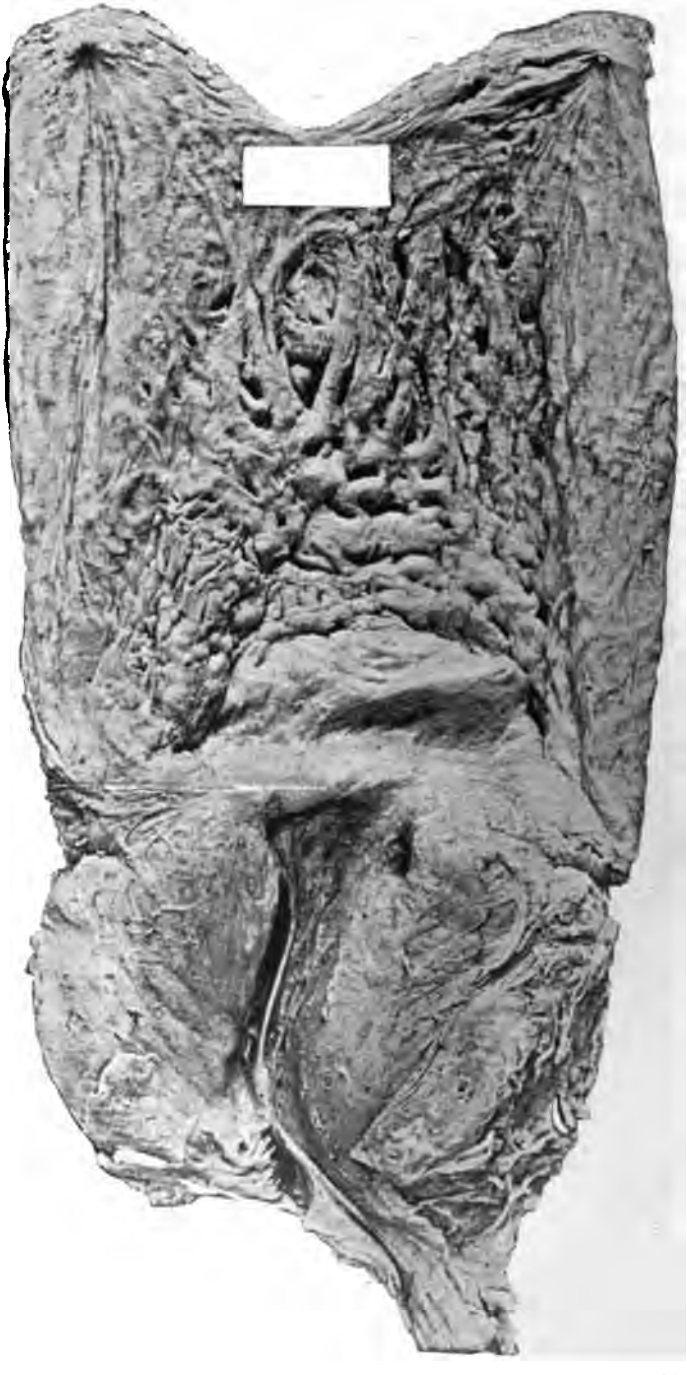
Obstruction by the median portion of the prostate. (Specimen in Museum of Philadelphia Hospital.)

Fig. 228.



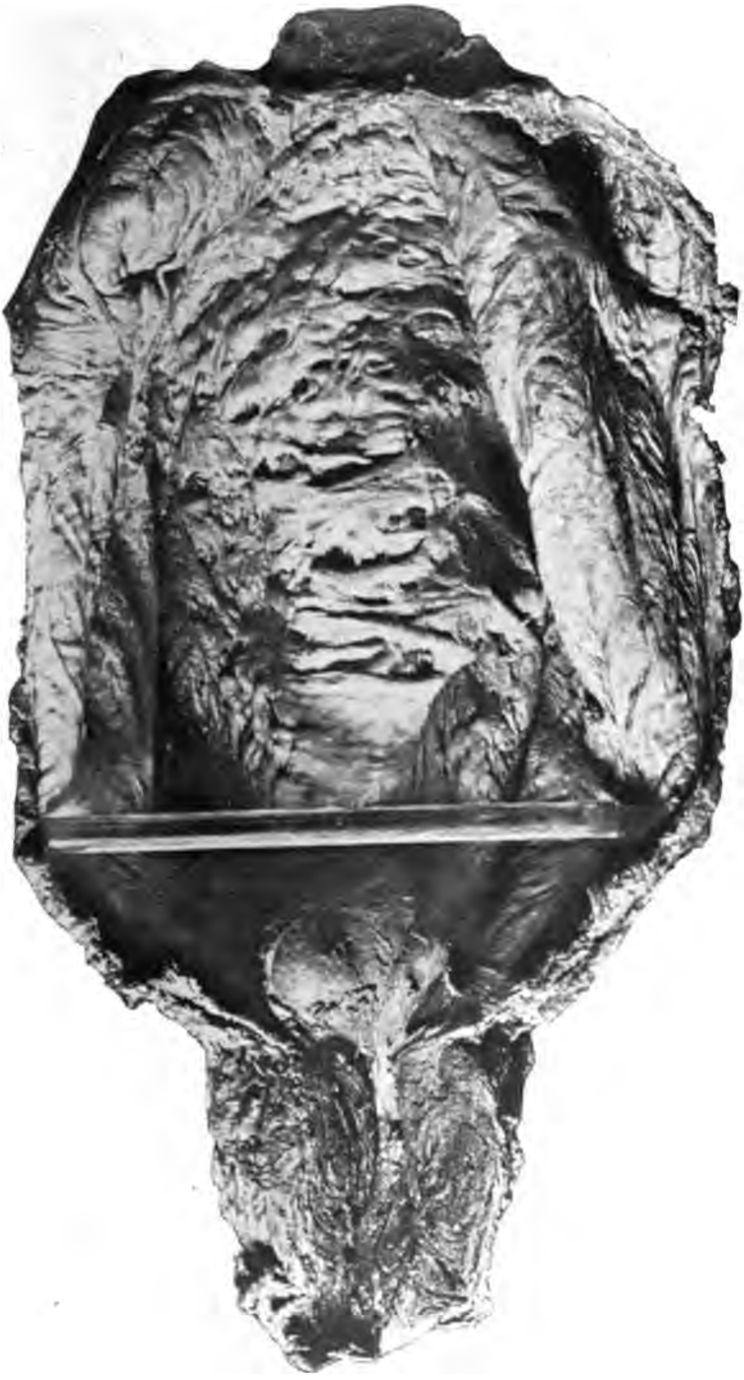
Separate tumors springing from the lateral lobes of the prostate. (Watson.)

Fig. 229.



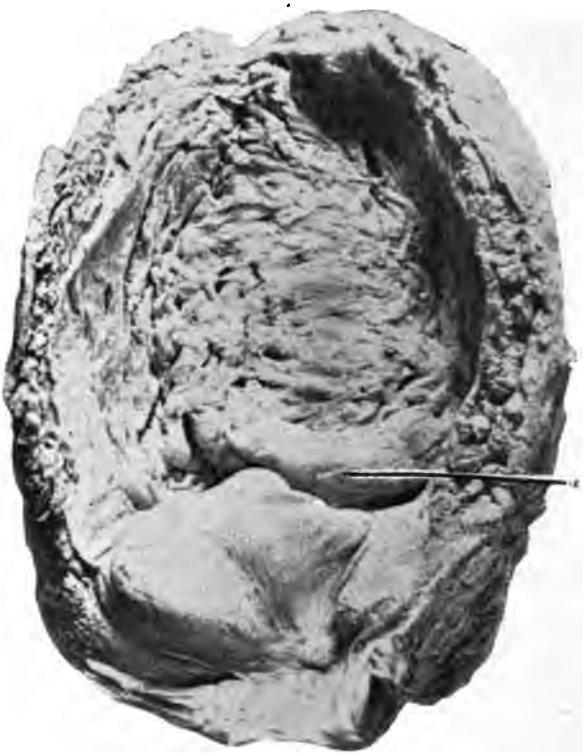
Bilateral hypertrophy of the prostate. A thick rigid bar at the neck of the bladder unites the two lateral lobes. (Watson.)

Fig. 230.



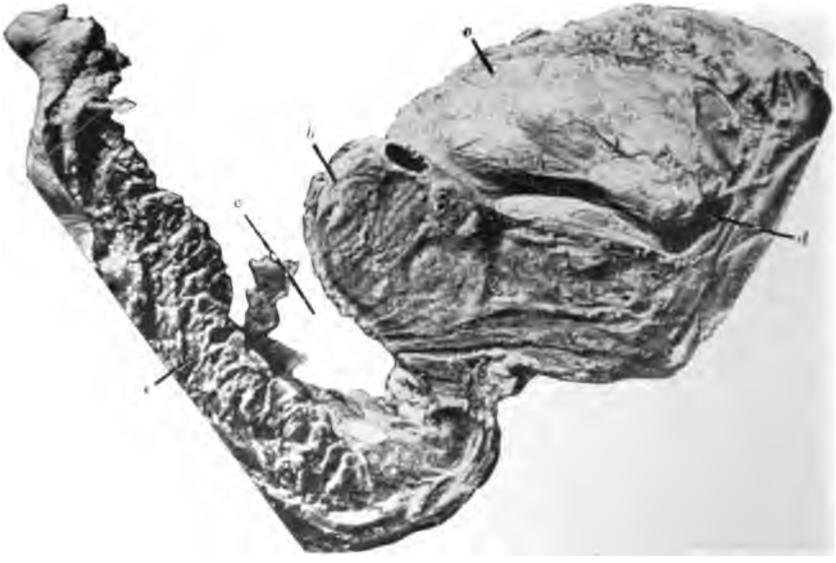
Hypertrophy of the median lobe of the prostate. (Watson.)

FIG. 231.



Hypertrophy of the median and one lateral lobe of the prostate. *a*, interureteral bar. (Watson.)

FIG. 232.



Bladder and prostate cut through longitudinally in the median line. *a*, lateral lobe; *b*, median lobe; *c*, depression behind the middle lobe called the bas-fond; *d*, prostatic urethra; *e*. bladder-wall. (Watson.)

lobes encroaching to some extent upon the urethral lumen. If the enlargement is progressive it is likely to be somewhat irregular, certain portions of the gland increasing more rapidly than others. The posterior isthmus, the so-called median lobe, is frequently affected, though the bulk of the growth may occupy one lateral lobe, or bosses may project from both lobes and the isthmus, producing great distortion of the urethra, diverting it from its normal course, and sometimes considerably lengthening it. (Figs. 232, 233.) The growth is most rapid in the lower posterior isthmus (median lobe).

In its overgrowth the prostate may be greatly enlarged and soft, indicating a preponderance of glandular overgrowth; may be moderately enlarged, or even small and hard, suggesting an excessive stromal proliferation, particularly of the connective-tissue elements, or may represent a combination of these two types.

The large, soft nodules are readily shelled out from the thickened capsule. In the atrophic forms of enlargement the capsule is densely adherent, and in total operations must be stripped from the fascial sheath.

The enlargement may be general and symmetrical, or may involve chiefly the right, left, or median lobe, or combinations of two of them.

The direction of growth may be towards the bladder, the urethra, or the rectum. The overgrowth may be limited to the posterior isthmus, which may form a projecting intra-urethral or intracystic sessile or pedunculated mass (bar at the neck of the bladder) (Figs. 227, 230), which may seriously interfere with urination. The anterior commissure (isthmus) has only exceptionally been involved. Hypertrophy commonly involves the three lobes and is progressive, though somewhat unevenly, in all. Its projection upward and backward is incident to lessened resistance, the fascial investment limiting its downward and forward growth.

As to the amount of overgrowth, this varies within wide limits. The tumor may be little larger than normal, or may reach the size of an orange or even of a cocoanut.

Far more important than the position and size of the growth are the alterations it causes in the length, direction, and calibre of the prostatic urethra, and in the patulousness of the neck of the bladder. In consequence of the increase in thickness and the upward and backward growth of the lateral lobes, the transverse diameter of the urethra is lessened, and its length is increased in some cases by as much as three and one-half inches. If the growth is asymmetrical, the canal will be deflected from its regular curve. Thus, if the median portion enlarges more rapidly than the lateral lobes the floor of the urethra is lifted up, forming an abrupt projection, which effectually prevents the introduction of the ordinary silver catheter. When one lateral lobe is developed more than another there is lateral deviation, with the concavity of the curve towards the most affected side. Overgrowth of the median commissure may result in the formation of a pyriform tumor, which projects at the vesical end of the urethra, leaving a passage on either side.

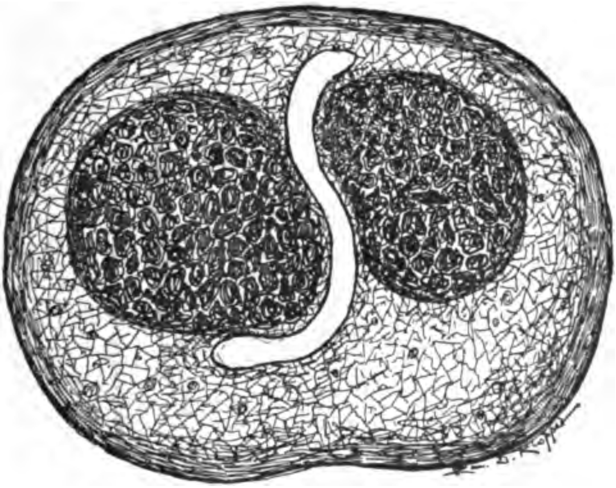
The posterior commissure growing backward into the bladder may become pedicled, forming a true valve; commonly it is sessile. The lateral lobes may project backward about the vesical neck in the form of multiple tumors, which encroach upon the vesical cavity and lift the neck above the level of the base, forming two vesical pouches, one above and in front, behind the pubis, the other below the prostate in the bas-fond. The lower pouch is usually caused by overgrowth of the posterior commissure (median lobe). (Fig. 232.) Between the ureters there is normally an interureteral bar, made up of muscular fibres, not distinguishable, except by dissection, in the normal bladder; this bar becomes greatly hypertrophied in enlarged prostate because of the frequent straining efforts to expel urine from the region in which it is apt to accumulate and cause irritation.

Pathology.—The chief characteristic of a microscopic section from an enlarged prostate is glandular hyperplasia. The ducts and acini may be dilated, and the latter coalescent, and lined with either a single layer of epithelium or so filled with cells as to simulate cancer. Malignant degeneration of an enlarged prostate has been frequently observed by Albarran, and when the epithelial cells are observed breaking through the basement membrane and infiltrating the stroma the diagnosis of beginning cancer can be made with some certainty. The epithelial lining of both the ducts and acini may entirely disappear, and the latter may be represented by fibrous tissue. The acini are at times distended with inflammatory products, forming multiple chronic abscesses in the substance of the gland, or they may be filled with their own secretion, which exhibits a tendency to form concretions.

The stromal outgrowth is usually made up of an increase in connective tissue, the smooth muscular fibres exhibiting a tendency to disappear, though true myomatous overgrowths have been observed. There are scattered through it areas of round cell infiltrate, suggesting inflammation. Section of an enlarged prostate shows upon examination a series of projecting spheroidal lobulations which can be readily shelled out from the surrounding tissues. These fibro-adenomatous masses vary from the size of a pea to that of an egg, and represent overgrown lobules, each with its fibroid or fibro-muscular investment and glandular centre.

There is no evidence to show that the small hard prostate is a secondary stage of the large soft enlargement, nor that the type characterized by gland hyperplasia becomes ultimately converted into the form which exhibits predominance of fibroid tissue. Each form seems to begin and to progress independently. The pathological changes in the bladder, ureters, and kidneys, incident to prostatic outgrowth, are those incident to obstruction in old men, whose bladders are undergoing muscular degeneration and have already been described. (See page 297.) They lead inevitably to renal insufficiency and uræmia, usually heralded by a sudden gastro-intestinal breakdown.

FIG. 233.

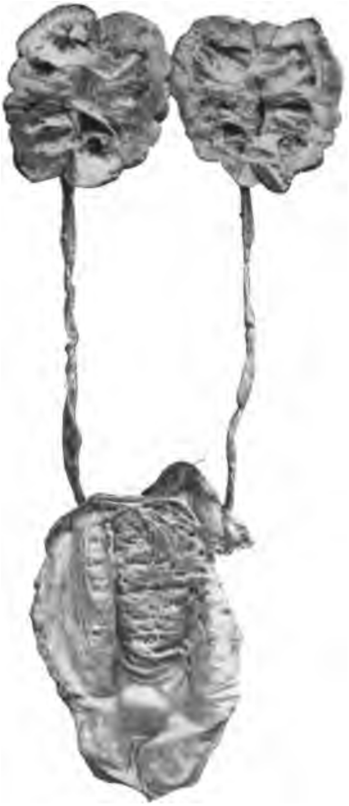


Distorted urethra from enlarged prostate. (Murphy.)

Ætiology.—The evidence derived from the more recent pathological studies of the prostate gland points somewhat to the dependence of this condition upon chronic inflammation which remains latent, in so far as symptoms are concerned, until the organ reaches large dimensions or so distorts the urethra as to cause urinary obstruction. Irregularly distributed through the stroma there is practically always a round cell infiltration most marked about the urethra; in the stroma surrounding the ducts and acini are seen either fibroblasts or true cicatrices. Pressure upon this infiltrate by obstructing the ducts may cause their glandular overgrowth or possibly true cyst formations. If this is uniform, the tissue is so widely diffused through the prostate that the acini themselves are compressed and atrophy will result. Usually the connective-tissue cells remain of the embryonal type and by their proliferation produce enormous tumors made up of connective tissue. Should they undergo cicatricial contracture, the prostate may become smaller than normal, and this condition is at times noted.

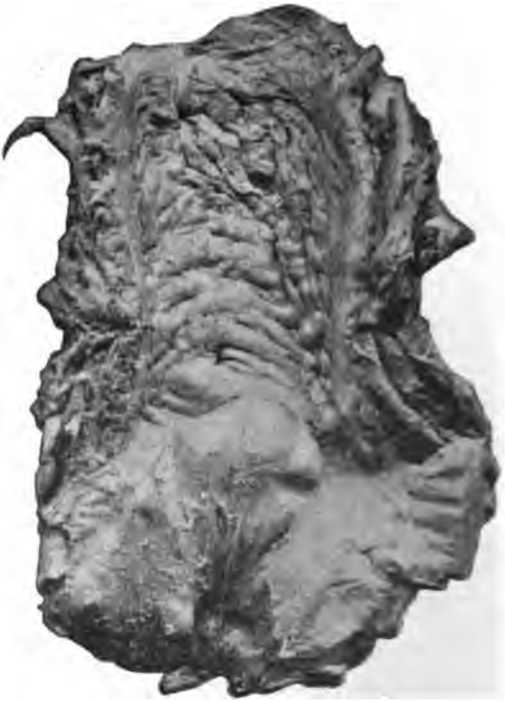
Against the inflammatory theory of prostatic enlargement it may be said that it is a disease of declining years, having been rarely observed before the age of fifty, that no relation can be traced between its development and a history of preceding acute or chronic prostatitis, that thirty-three per cent. of men above sixty show some evidence of enlargement, and that practically the prostates of all men past middle age are shown on microscopical study to be subject to the same adenomatous change which in its more complete development is called prostatic hypertrophy.

Fig. 234.



Prostatic obstruction. Effect on bladder and kidneys. (Specimen in Museum of Philadelphia Hospital.)

Fig. 235.



Prostatic obstruction with hypertrophy of the bladder-wall and contraction of its cavity. (Specimen in Museum of Philadelphia Hospital.)

As a working hypothesis the following explanation has been suggested (White):

The function of the testis, like that of the ovary, is twofold,—the reproduction of the species and the development and preservation of the secondary sexual characteristics of the individual. The need for the exercise of the latter function ceases when full adult life is reached, but it is possible that the activity of the testis and that of the ovary in this respect do not disappear coincidently, and that hypertrophies in closely allied organs like the prostate and the uterus are the result of this misdirected energy. This hypothesis would increase the analogy between the fibromyomata of the uterus and the adenofibromata of the prostate, which, from a clinical stand-point, is already very striking, and is further strengthened by the almost identical result of castration in the two conditions.

The dependence of prostatic enlargement upon general atheroma remains to be proved, though it is undoubtedly true that these two elements are often associated and are common at the same period of life. There is a variety of overgrowth in which the prostate becomes excessively hard, showing little alteration in shape or size, but giving rise to marked obstruction may have for its cause a general sclerosis, though it is more probably due to fibroid degeneration following chronic inflammation. Richardson states that "the change in the prostate appears to be as common as gray hairs." "It is not a disease process."

Symptoms.—The symptoms of enlarged prostate are mainly dependent upon interference with the function of micturition: hence it is possible, when the overgrowth occupies such a position in the gland as not to interfere with the calibre, dilatability, or direction of the urethra, that it may attain large proportions before any symptoms are excited. As soon as the tumor grows in such a direction or reaches such size that the urethral calibre is distinctly encroached upon, the patient will notice that—(1) Micturition is unduly frequent, this frequency being most marked during the night or in the early morning. (2) There is some delay in starting the stream, and this does not flow with its wonted force, falling almost directly from the penis without the customary parabolic curve. (3) There is a tendency to dribble on the completion of the act of micturition.

Provided infection does not take place, with the development of posterior urethritis and cystitis, these may be the only symptoms of which the patient complains until the distention of the bladder reaches such a point that incontinence of retention develops. As a rule, long before this there is set up a certain amount of urethritis and cystitis. There are then added to the obstructive symptoms—*i.e.*, frequency, most marked at night, slowness in starting the stream, loss of force, and dribbling—the symptoms of inflammation, pain, and suppuration. The pain may be manifest in the form of a sensation of weight; of a weak and tired feeling, of an ache which may be steady or intermittent, or sharp or dull pains may be felt in the perineum, scrotum, hypogastric region, groins, inner surfaces of the thighs, back, and testicles. Later there are pains above the pubis and sharp, shooting pains in the urethra behind the glans penis. Urination becomes excessively frequent and painful, is attended with violent straining, and is suddenly and frequently interrupted; the stream is small and broken. The urine becomes alkaline and offensive, is turbid with pus and mucus, and there is often a muco-purulent urethral discharge.

Frequency of urination in cases with non-infected bladders is due to residual urine. This occupies the space that should be taken up by fresh secretion from the kidneys, and hence causes the bladder to become distended sooner than would be the case normally. The amount of residual urine is proportionate to the degree of obstruction, and as it increases in quantity it causes gradual distention of the bladder-walls, with atrophy and degeneration of the vesical muscles, nearly always preceded by hypertrophy incident to the efforts made to overcome resistance.

The frequency of urination is in the absence of inflammation proportionate to the degree of vesical distention. This symptom is especially distressing because it is most pronounced during the night, in advanced cases compelling the patient to rise every half-hour. Nocturnal frequency has been ascribed to the more irritating nature of the urine secreted at night and to the increase in the quantity secreted. This may be true in part, but it may be doubted if urination is really much more frequent in the night than in the day. All night disturbances make a much deeper impression than those by day, and anxiety exaggerates a few disturbances into a constant series. It must be borne in mind that when the patient micturates once during the night it is significant, and the gravity of this significance increases with the frequency of the act.

Residual urine, and hence frequent urination, are more marked and earlier symptoms when there is hypertrophy projecting backward from the median portion of the prostate. Owing to the altered relation produced by the overgrowth of the neck of the bladder, a pouch is formed about the outlet. In this a certain amount of urine is contained which the atrophied and degenerated bladder-walls are unable to expel. This pouch increases in size as the bladder becomes distended, until a condition of chronic tension is reached, characterized by an incontinence which in prostatics is nearly always indicative of retention.

Loss of force in the stream is due in part to atony and degeneration of the bladder-muscles, in part to the urethral obstruction. Slowness in starting micturition and dribbling on the completion of the act are caused partly by the atony, partly by reflex spasm of the compressor urethræ muscle.

Very exceptionally complete retention of urine is an early symptom of hypertrophy. It is then an expression of acute congestion incident to excess, exposure to cold, etc. In the later stage of the affection it is due to permanent overgrowth. As a result of vesical and renal retention there is always polyuria, the urine being of low specific gravity. This hypersecretion of urine is one cause of frequency, and this fact should be remembered in estimating the bladder-capacity and the significance of frequent urination.

As the disease progresses, in consequence of severe straining, hemorrhoids, rectal prolapse, or abdominal hernia may develop. Ultimately, if the obstruction is untreated, there will be dilatation of the ureters and kidney pelves, and in infected cases the development of pyelonephritis and uræmic poisoning.

Exceptionally there is bleeding. This may be severe and spontaneous, in which case there is usually relief of symptoms. It is commonly due to instrumentation. The presence of albumen in the urine does not necessarily indicate involvement of the kidneys, since this may be due to the constant straining and frequent micturition. Calculus not infrequently develops.

It is evident that the symptoms of enlarged prostate are those of obstruction to the passage of urine, to which are ordinarily added symptoms of inflammation. The obstructive symptoms are comparatively painless, and are slowly progressive; they ultimately bring about changes in the upper urinary tract, which lead to gastro-intestinal disturbance, uræmia, and death. Inflammation converts this slow, painless disease into one that is extremely painful, is often rapid in its course, and is immediately threatening to life. From this consideration the importance of strict cleanliness in dealing with cases of enlarged prostate is evident.

Diagnosis.—In the presence of the symptoms of prostatic obstruction in a man over fifty-five years of age,—*i.e.*, a full-sized but feeble stream started with difficulty, frequent urination, most marked at night, and a feeling as though the bladder were not completely emptied,—a positive diagnosis may be made by direct examination.

The first step in this direction consists in the introduction of a finger into the rectum.

The patient standing with his legs apart and leaning forward, his hands upon a table or chair, the index-finger protected by a cot is introduced through the sphincter, and an effort is made to feel the apex of the prostate. As the finger is entered more deeply the lateral outlines of the gland are explored, and its density, the irregularities of its surface, finally the height to which it reaches, are noted, the finger being carried on until the soft bladder can be felt above the upper border of the prostate. In these subjects bimanual palpation is distinctly serviceable. It will be remembered that the normal prostate is about the size of a horse-chestnut, is often cordate in shape, with the base upward towards the bladder, is not very sensitive to pressure, and can be clearly outlined by rectal palpation. Above it the bladder-wall can be felt.

The next step in direct examination consists in the introduction of urethral instruments. This will enable the surgeon to determine the extent to which the prostatic portion of the canal has been lengthened, the thickness of the gland, the presence of lateral deviations, and the general nature of an obstruction placed at the neck of the bladder.

For the purpose of determining the extent to which the urethra is lengthened, a soft elbowed catheter is employed. Urethral length varies so greatly in individuals that it is impossible to establish a standard which will apply to each case. Perhaps, as a rule, it is safe to conclude that if the catheter has to be passed more than eight and one-half inches to evacuate the urine from a bladder containing three or four ounces, the prostate is enlarged. A more accurate way of arriving at the length of the prostatic urethra is to determine the length of the anterior urethra by passing an acorn-headed bougie to the anterior layer of the triangular ligament. A catheter is then introduced into the bladder containing but a few ounces, and when urine begins to flow the point on its shaft corresponding to the position of the meatus is marked. When the catheter is withdrawn, measurements are taken from this point to the end of the eye. Subtracting the anterior urethral length from the total length, the remainder represents the length of the prostatic and membranous portions of the canal; three-quarters of an inch can be allowed for the membranous urethra. Should the prostatic urethra be found over one and three-quarter inches long, the diagnosis of enlargement of the prostate is reasonably assured.

Metal instruments are employed to determine the presence of lateral deviations of the prostatic urethra, the thickness of the enlarged gland, and the seat and projection of growths about the neck of the bladder. They should never be grasped tightly when they are introduced. A stone searcher when it can be introduced without the use of undue force is best adapted to the purpose. Pressure should be gentle, and so directed that the instrument may follow any slight irregularities in the direction of the prostatic urethra. It will often happen that before the instrument can be made to enter the bladder the handle must be considerably lateralized, showing deviation of the urethra to one side, or when the middle portion of the prostate is enlarged and projects upward the handle may have to be depressed much more than is usually the case. When the instrument has entered the bladder, palpation against its shaft through the rectum may give an approximate idea of the antero posterior diameter of the gland. The beak of the instrument is then turned in all directions, and a careful exploration is made for stone, since this is a frequent complication of prostatic enlargement. After exploration of the bladder is completed the instrument is withdrawn until the beak lies just within the internal vesical sphincter. Then, by turning it from side to side, not only can the base of the bladder be explored, but polypoid tumors, which sometimes project about the neck of the bladder, can be distinctly felt. In case of a healthy bladder and prostate, the rotation of this sound when its beak is still within the neck of the bladder is unattended with resistance. If there is marked hypertrophy, and particularly if the middle portion of the prostate is affected, jutting back into the bladder, the beak of the instrument cannot be rotated in this way, but will encounter a resistance from which it can be freed only by greatly depressing the handle. For the purpose of determining by instrumentation which lateral lobe is enlarged, Mercier, after having explored the bladder, withdraws the instrument, keeping its shaft as nearly horizontal as possible as it traverses the prostatic urethra. The shaft of the bougie will be deflected to the side of the greatest enlargement; in cases of symmetrical enlargement there will be no deflection.

The patency of the urethra and the encroachments upon its calibre by prostatic outgrowths are best ascertained by introducing full calibre solid steel instruments, or silver or soft English catheters. If these instruments are arrested at a point more than seven inches from the meatus, the obstruction is in the prostatic urethra. If an instrument with a prostatic curve is arrested at the same point, but on continued pressure passes on into the bladder, often with a distinct jump, and if a

Mercier elbowed catheter goes in without difficulty, the obstruction is probably one caused by upward projection of the urethral floor, and its distance from the meatus can be measured by the solid sounds. If the moderately stiff Mercier catheter will not pass, but a very small gum catheter or one of the rat-tail pattern enters, the urethra is probably deflected to one side or the other. If all instruments enter readily, but the outward flow of urine is decidedly interfered with, the obstruction is valvular.

The amount of residual urine is determined by directing the patient to empty his bladder, and then introducing a soft catheter and drawing off what remains. Normally no urine should flow through this catheter, or at most a few drops. Measurements of the urethral length can advantageously be made during this portion of the exploration.

The tonicity of the bladder is estimated by the force with which the urine is propelled through the catheter.

The cystoscope is serviceable mainly in demonstrating intravesical growths about the bladder-neck, in enabling the surgeon to determine the degree of cystitis, and in affording a view of the ureteral orifices. From observation of the regularity and vigor with which they eject the urine an estimation as to the functional activity of the kidneys may be made. In some cases it may be possible to catheterize the ureter, and thus to determine absolutely by examination of the drawn urine the condition of each kidney and its pelvis. This is, however, likely to be difficult in cases of enlarged prostate.

The differential diagnosis of obstruction from enlarged prostate must be made from that due to stricture, to chronic posterior urethritis, to chronic prostatitis with contracture of the internal vesical sphincter, to calculus, to bladder-tumors, to vesical atony, and to paralysis.

In stricture there is a small stream which often has considerable force; in prostatic obstruction the stream may be large, but is without its normal parabolic curve. Stricture, as a rule, attacks young men, enlarged prostates are chiefly observed in old men. Stricture causes obstruction to the passage of the instruments within six and a half inches of the meatus; the obstruction of enlarged prostate is more than seven inches from the meatus. There is no increase in urethral length in stricture, this is nearly always present in enlarged prostate.

Chronic posterior urethritis is commonly observed in young and middle-aged men, and is often a sequel to gonorrhœa; there is little or no increase in the size of the prostate, by either rectal or urethral examination; there is constantly a small quantity of pus in the urine, and the force of the stream is not markedly diminished, although there may be trouble in starting it and an imperfect cut-off. There is no residual urine.

Chronic prostatitis associated with contracture of the internal vesical sphincter is especially characterized by retention of urine, slowly but persistently progressive and rarely absolute—no prostatic enlargement is found either by rectal palpation or urethral examination—the urethral length may be shorter than normal, and the cystoscope and sound fail to demonstrate irregularities about the bladder neck. This form of prostatitis may or may not be accompanied by the symptoms of chronic posterior urethritis. If obstruction to instrumentation is detected it is found at the internal vesical sphincter.

Vesical calculus is most painful, and causes most marked frequency of urination when the patient is up and about, and the symptoms are markedly alleviated by rest in bed. Unusually severe pain and tenesmus, especially if associated with pus and blood in the urine, and if paroxysmally persistent, should always suggest the presence of stone in the bladder. Rectal examination and instrumental exploration of the bladder should at once establish the diagnosis, since a calculus can usually be readily felt.

Intravesical tumor may closely simulate the symptomatology of enlarged prostate. Hæmaturia is, however, pronounced, and becomes progressively more severe. Rectal and cystoscopic examinations will establish the diagnosis.

The diagnosis of hypertrophied prostate from atony or paralysis of the bladder is dependent upon the history of the case and upon exclusion of enlargement of the prostate by rectal and urethral examination.

The clinical classification of cases of prostatic enlargement should be made from the stand-point of the degree of urinary obstruction occasioned by the gland and the presence or absence of vesical infection. Retention is the symptom of obstruction. This may be acute or chronic, partial or complete. The incomplete chronic retention may or may not be accompanied by vesical distention. Any of these forms of retention may be complicated by infection. The acute complete retention is usually observed in men who have exhibited symptoms of moderate obstruction and is due to sudden congestion of the prostate. In most of these cases there has been a previous long-standing condition of incomplete retention with or without bladder dilatation.

Chronic complete retention is practically always accompanied by vesical dilatation. In this condition no urine is passed by voluntary effort. Chronic incomplete retention implies the ability partially to empty the bladder, a residuum being left which may not greatly increase if the bladder-walls become thickened by muscular overgrowth or inflammatory infiltrate and organization, or which may gradually produce enormous distention, the overflow then passing both voluntarily and involuntarily.

A distended bladder is prone to infection, and this is particularly true of a viscus which has not been subject to instrumental treatment: hence in all these clinical manifestations of obstruction the passage of a catheter is likely to be followed by cystitis, which, once started in these senile and obstructed bladders, is exceedingly hard to cure. The presence or absence of cystitis as shown by the symptoms and by the examination of the urine has a distinct bearing on treatment as has the ascending infection represented by pyelitis and pyelonephritis.

Retention, if progressive, inevitably results in vesical atony and distention, and ultimately in interstitial nephritis and renal insufficiency. At times it is accompanied by hemorrhage from the dilated veins of the prostatic or vesical mucosa, exceptionally spontaneous, usually provoked by instrumentation. Inflammation may involve the mucous membrane of the entire genito-urinary tract. Cystitis, though usually first excited by catheterism, may arise independent of this, and, unless obstruction be removed, ultimately involve the ureter and renal pelves. Vesical calculus is a common sequel of cystitis and residual urine, and epididymitis is a common complication of catheterism when the bladder and posterior urethra are infected.

Prognosis.—Aside from its obstructive effect upon the urinary flow and its tendency towards malignant degeneration, prostatic overgrowth is a harmless affection. When, however, the function of micturition is seriously disturbed and the obstruction is steadily increasing, the prognosis in the absence of mechanical treatment is absolutely bad. Men of over sixty years commonly enough exhibit a symptom-complex characterized by frequency of urination, especially at night, slowness in starting the urinary stream, intermittence and lack of force in its propulsion, and dribbling at the end. On rectal examination the prostate shows the moderate enlargement common at this time of life, and on catheterization there is a small quantity of residual urine, the instrument entering the bladder easily and the urethra not being lengthened. This condition is incident rather to senile atrophy of the vesical detrusor muscle than to mechanical obstruction, and is so slowly progressive that direct treatment is rarely required, nor in itself does the condition seriously threaten the general health.

When the obstruction is sufficiently pronounced to produce retention of not more than four ounces, and there is no infection, the patient may remain undisturbed in general health for many years. When, however, the bladder becomes permanently distended, or when cystitis develops either with or without distention in the presence of residuum, the prognosis in the absence of treatment is absolutely bad.

Vesical calculi are prone to develop; atony of the bladder with hypertrophy of its wall almost surely ensues; and hydronephrosis is a common sequel. These complications greatly intensify the gravity of a given case.

TREATMENT OF ENLARGED PROSTATE.

The PALLIATIVE treatment of enlarged prostate has for its end the maintenance of the general health of the patient, the avoidance of pelvic and renal congestion, and the adoption of measures which prevent intravesical tension and avoid infection, or, if this has already developed, apply measures appropriate for its cure.

HYGIENIC TREATMENT.—Careful attention to the general health of a patient suffering from prostatic enlargement is of cardinal importance, since comparatively slight disturbances, such as acute attacks of indigestion, exposure to cold, or excess in eating and drinking, may, by adding the element of acute congestion to the chronic engorgement of the prostate, bring on an attack of retention, which may permanently cripple the bladder. The diet must be carefully regulated, the needs and idiosyncrasies of each patient being considered. In general, sweets, pastries, exclusively nitrogenous diets, and highly spiced foods should be avoided. Alcohol may be taken in moderation, well diluted, after meals, though it should be allowed only when the general atonic condition of the patient indicates that it is likely to be useful; in robust individuals its use should be prohibited. Thompson highly approves of cider in certain cases. This should be neither sweet nor markedly acid. Milk, buttermilk, effervescing alkaline mineral waters, are all serviceable. Smoking in moderation, if it has been a habit, need not be interdicted. Among the articles of food which should be strictly forbidden are pork in all its forms, cheese, raw fruits, and sugars. Most careful attention should be paid to the condition of the bowels, and regular evacuation should be secured daily by the use of Vichy or Hunyádi water or enemata.

Clothing should be regulated in accordance with the weather, chilling of the surface being particularly avoided. The acute congestive attacks so common in the course of chronically enlarged prostate are especially apt to result from cold, wet feet. The skin should be kept in good condition by daily cold sponging followed by brisk rubbing with a flesh-brush. Moderate exercise in the air is always serviceable; in some cases horseback riding is attended by no ill effects; in other cases the jolting markedly increases congestion, as is evidenced by obstructive symptoms. Walking, driving, the use of gymnastic apparatus, calisthenic motions employed regularly, are all serviceable.

The sleeping hours should be sufficient for rest, but long lying in bed should be discouraged. Prostatic patients are always better when they are up and about. When the patient is much annoyed by frequent urination at night, a hot bath before retiring will be found serviceable.

The most frequent and most potent causes of pelvic engorgement, and hence of sudden increase in the obstructive symptoms due to enlarged prostate, are—1. Retaining the urine for a considerable period after the desire to urinate becomes urgent. 2. Chilling of the surface. 3. Sexual excitement. 4. Over-indulgence in eating and in the use of alcohol. 5. Constipation.

The therapeutic or rather prophylactic indications are sufficiently plain.

MEDICINAL TREATMENT.—Of the drugs which may be employed with any hope of benefit in cases of enlarged prostate but little can be said. No drug seems to have a specific influence upon the prostate, unless it is ergot, which is administered on the plausible theory that this gland, being possibly the analogue of the uterus, may respond in a similar manner to similar influences. Ergot may be beneficial where hypertrophy of the muscular elements, as shown by the softness of the gland, predominates. It should be used merely as an auxiliary to other treatment. Salol, boric acid, and saw-palmetto, with belladonna and the bromides, will often be serviceable in the treatment of the inflammatory complications of hypertrophied prostate, notably cystitis. Sodium iodide in doses of three grains, three times a day, is valuable as a means of retarding the development of arterio-sclerosis, which so commonly complicates prostatic hypertrophy, and hyoscine or hyoscyamine seems to exert a favorable influence on the function of micturition.

INTERMITTENT DILATATION.—A patient who presents the symptoms of a prostato-vesical congestion of the early stages of hypertrophy, who is disturbed once or twice at night, who has an enlargement of moderate density, appreciable through the rectum, but not offering much resistance to the introduction of an ordinary catheter, and who has but little residual urine, is likely to derive great benefit from the systematic introduction of full-sized steel sounds. This treatment, and this alone, often relieves existing symptoms, and prevents, or, at least, delays the development of further trouble. That it can have any curative effect is unlikely; that it can even modify to any extent the continuous enlargement of the gland seems improbable; but that, either by producing a local atrophy in the parts immediately surrounding the urethra, or by simply stretching the canal itself and relieving local congestion and tumefaction, it mitigates the early symptoms, lessens the vesical irritability, diminishes the amount of residual urine, and modifies favorably the whole course of the case, is beyond all doubt. The largest steel sound which the membranous urethra will permit to pass is introduced every fifth day, and is allowed to remain in place for ten to fifteen minutes, or longer if the patient is in bed. Preliminary irrigation of the urethra, careful sterilization of the instrument, and gentleness in its introduction render the treatment free from objection, and intelligent patients carry it on for themselves for years.

RECTAL INJECTIONS.—These may be hot or cold, as the patient prefers, and may be of normal saline solution when ordinary water congests and irritates the mucous membrane of the rectum. The stream of water should be thrown forcibly upward and forward directly against the prostate, and the injecting-pipe should be provided with openings through which the liquid escapes at once without distending the rectum.

MASSAGE is useful, not so much because it causes shrinking of the prostate as because of its tonic effect upon the walls of the blood-vessels, thus diminishing congestion and rendering the circulation more normal. Sometimes it seems to irritate the prostate; in this case it should be discontinued. It is particularly serviceable in the treatment of prostatism associated with small prostates.

Catheterism.—The catheter is used for the relief of retention. It may be required occasionally, as in cases of acute retention without distention, habitually, as in cases of chronic retention with or without distention, or continuously, as in cases of infection with systemic absorption. In using a catheter for the relief of retention that instrument should be selected which enters the bladder most easily, usually an elbowed soft rubber catheter. Each introduction should be preceded by urethral irrigation, preferably with protargol solution 1 to 2000, since the anterior urethra is always infected. (For details of Catheterism, see page 317.) All forms of urinary retention caused by enlarged prostate are amenable to treatment by regular cleanly catheterization, and in those cases characterized by acute complete retention this treatment may be curative, at least to such an extent that the patient is again able to void his urine and is troubled only by frequency, some loss of power in the stream, and a residuum too insignificant to produce symptoms. In all other forms of retention, either with or without infection, the catheter may serve a useful purpose in delaying the progression of symptoms and saving the kidneys from irremediable damage.

On general principles it should be used for the relief of complete retention as often as is needful to prevent the bladder from containing more than twelve ounces at a time; in incomplete retention once in twenty-four hours for each four ounces of residuum contained by the bladder. It should be supplemented by mild antiseptic urethral and vesical irrigations, and these are absolutely indicated in the presence of cystitis. In the latter case, vesical irritability associated with inability to pass any water at all, or at most a few drops, may require the use of the catheter much more frequently, this being particularly the case when there is incomplete retention in a non-distended infected bladder.

When, because of back pressure or infection, or a combination of these conditions, renal insufficiency develops, characterized by gastro-intestinal breakdown, hebetude or somnolence, and other uræmic manifestations, or by septic fever, continuous catheterization is peculiarly serviceable. The objections to habitual catheterism in chronic prostatics are the risks of vesical infection and the production of chronic atony. These, though serious, are not sufficient to contraindicate the employment of the method under all circumstances.

Infection may often be avoided by the administration of moderate doses of urinary antiseptics by the mouth, salol being particularly serviceable, but in doses so small as not to irritate the kidneys, and by scrupulous and unflagging care as to asepsis. Vesical atony is avoided rather than encouraged by systematic catheterism, and though the average expectation of life of a patient beginning the habitual use of the catheter is not over five years, in selected cases—if the method can be intelligently applied, causes no discomfort, and is not followed by infection—it may be continued with safety for many years.

The complications incident to catheterization are: difficulty in the introduction, either mechanical or incident to pain, in the latter case greatly relieved by preliminary instillations of four per cent. eucaine solution; urethritis, prevented by irrigation each time the instrument is passed; epididymitis, prevented, if recurring, by vasectomy; and hemorrhage, avoided by the proper selection of the instrument and extreme gentleness; and infection, prevented by antiseptic irrigations and cleanliness.

As a rule, when habitual use of the catheter is required, the patient's best interests will be consulted by advising operation. This may take the form of—

1. Over-dilatation of the internal vesical sphincter, applicable to cases of small hard prostates, complicated by sclerosis of the sphincter.
2. Prostatotomy, or incision of the internal vesical sphincter and prostate, particularly applicable in the small sclerosed prostate.
3. Prostatectomy, or total enucleation of the prostate gland, applicable to all cases of prostatism complicated by an increasing residuum with or without distention of the bladder or with or without infection.
4. Cystostomy, applicable to cases of inveterate cystitis, in which the systemic condition is such as to make unjustifiable the more radical procedure.
5. Castration or vasectomy, applicable to those cases suffering from enlarged prostate who properly should be subjected to radical procedure but who reject the knife, and especially if efficient drainage by either intermittent or continuous catheterization is also not practicable; to some cases obviously unable to bear the shock of prostatectomy; and occasionally (vasectomy) as a preliminary or possible palliative when a later radical operation is contemplated.

Before any form of operative treatment is undertaken, a careful examination of the urine should be made to determine whether or not the kidneys are competent. This should include an estimate of the urea excreted in twenty-four hours, together with findings of the usual chemical and microscopical examination of the urine and the results of the phloridzin test. (See page 383.) If renal insufficiency is thus demonstrated, an effort should be made to bring the kidneys to their highest functionating power before operation. This is best accomplished by attention to general hygiene, a milk, buttermilk, or koumiss diet, with as much water as can be taken without disturbing the stomach, and high rectal enemata of normal salt solution at body temperature. Moreover, it is of major importance under these circumstances entirely to relieve the kidneys of back pressure and to provide adequate drainage in cases of cystitis complicated by infection of the renal pelvis. This is most safely accomplished by continuous catheterization. When the use of the catheter is impracticable, cystostomy may be needful. If, in spite of these means and others having for their end the betterment of the patient's general condition, the kidneys remain incompetent, it is unwise to insist upon an operation as radical as that of total enucleation. If, however, by such a treatment the systemic symptoms of infection and of uræmia lessen or disappear and the urinary secretion becomes adequate, neither age nor vesical nor renal inflammation nor other complications of enlarged prostate should prevent the performance of the radical operation.

STRETCHING OF THE INTERNAL VESICAL SPHINCTER.—This is indicated in those cases of prostatism without prostatic enlargement. The obstruction to the urinary flow is here due to a sclerosed condition of the internal vesical sphincter, a muscle which in its normal state relaxes when the bladder contains three or four ounces of urine. This sphincter should admit the index-finger, but when, as a consequence of chronic prostatitis or inflammation about the vesical neck, it undergoes probably first hypertrophy and afterward fibroid degeneration, it forms a narrow hard ring into which the tip of the little finger can be passed only with difficulty, though it may admit a 28 sound passed through the urethra with only a slight sense of resistance.

Over-stretching of the prostatic urethra may be serviceable when enlargement of the lateral lobes causes obstruction by narrowing the urethra or rendering it tortuous. The slight bruising of the gland and the moderate laceration of the mucous membrane produced by over-stretching undoubtedly favor the development of infectious inflammation, but the risk is one which may be properly taken if the method lessens obstruction, since this is the chief cause of all the grave symptoms.

This operation may be accomplished under nitrous oxide by means of a dilating instrument which we have had constructed, especially for this purpose, the extreme calibre of which is seventy-five millimetres. (Fig. 63.) Stretching to forty-five, the extreme calibre of the usual prostatic dilator, is entirely inadequate.

In employing this treatment the urethra and bladder are first flushed with 1 to 2000 protargol solution. The distance from the meatus to the internal vesical sphincter is carefully measured and the instrument is introduced so that its dilating part lies exactly within the grip of this muscle. Its position can be further assured by the finger of an assistant in the rectum. The patient is then given nitrous oxide and the screw in the handle is rapidly turned until the dilating part reaches its full calibre. Excepting for the use of a bland diet and urinary antiseptics by the mouth, there is no after-treatment.

PROSTATOTOMY.

By this term is meant, incision through the internal vesical sphincter and into the substance of the prostate. It may be made either with the knife or with the galvano-cautery instrument through a perineal incision or through the urethra (Bottini's operation). Each has for its end, the removal of obstruction, by direct division in one case and by division supplemented by extensive sloughing in the other. Both are especially applicable to small hard prostates complicated by retention and probably by sclerosis and contracture of the internal vesical sphincter, though the advocates of the Bottini operation claim for its proper application, usefulness in nearly all forms and degrees of prostatic enlargement.

Perineal prostatotomy performed by the knife is useful in providing an efficient route for permanent drainage of the bladder, this procedure being especially indicated in those conditions of cystitis so pronounced that permanent catheterization is either unbearable or inefficient, and associated with a contracted, rigid, and inflamed bladder too small to be readily drained by the formation of a suprapubic fistula.

Perineal prostatotomy can be performed under local anæsthesia; it is, however, better to employ nitrous oxide, since not more than one or two minutes are required for the completion of the operation.

After preliminary antiseptic irrigation of the bladder, a grooved staff is passed, and upon this, by an inch long incision passing through the perineal centre, the membranous urethra is opened. The point of the knife engaging in the groove of the staff, the blade is passed into the bladder and then withdrawn, cutting forward and backward through the internal sphincter and into the substance of the prostatic commissure. The finger should then be passed along the staff and the latter withdrawn. Thereupon the interior of the bladder may be palpated. The vesical neck should be further dilated to at least 74 F. when the obstruction is due to contracture of the internal vesical sphincter. This may be accomplished by Spencer Wells forceps or a uterine dilator. A drainage-tube fully the size of the little finger and rigid should be so secured that its inner opening is just within the bladder, and to this tube should be connected a urinal placed at a level sufficiently low to drain the bladder. When it is intended to establish a permanent fistula, Watson's tube of hard rubber and designed especially for this operation will be found most efficient. When the drainage is meant to be temporary, the largest size soft rubber catheter (30 F.) will be found serviceable. Exceptionally, hemorrhage is so severe as to require packing. The bladder is irrigated at least twice daily with silver solution. The patient need not be kept in bed for more than a day unless this be indicated by his general condition.

A perineal fistula is less desirable than one placed suprapubicly, and should be formed as a permanent palliative measure only when the latter is impracticable.

Prostatotomy by the Galvano-cautery Instrument.—The prostate may be reached by the instrument passed through the urethra (Bottini), through an opening in the perineum (Chetwood), or through a suprapubic opening (transvesical prostatotomy).

This form of operation is especially indicated for the relief of obstruction incident to small sclerotic prostates intimately connected with and obstructing the urethra, and associated with sclerosis of the internal vesical sphincter; obstruction due to collar-like formations around the neck of the bladder which cause obstruction difficult to enucleate; or obstruction due to median sessile overgrowths of moderate dimensions. Moreover, it may be recommended as a compromise operation in cases which present indications for prostatectomy when the patient's consent cannot be secured for the radical form of surgical intervention. Galvano-cautery prostatotomy is contra-indicated in the presence of extensively diseased, greatly contracted bladders, especially when systemic depression is so profound as to contra-indicate any surgical intervention beyond the immediate and complete drainage of the bladder.

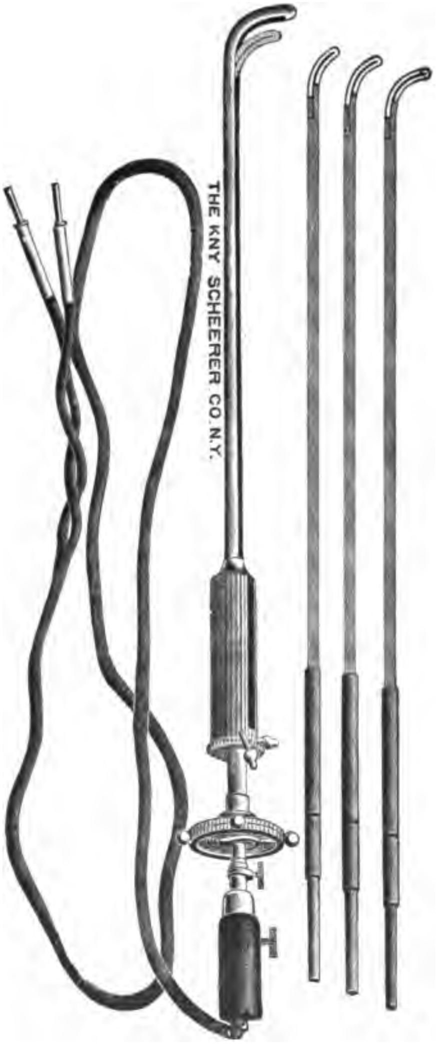
In selecting cases for galvano-cautery prostatotomy, knowledge gained from a cystoscopic examination conducted by one skilled in the use of the cystoscope is of great value. The preparation is the same as that appropriate for any other operation on the bladder, and includes antiseptic irrigation and the administration of urinary antiseptics.

For the performance of the *urethral operation*, Young's modification of the Bottini instrument should be the one selected, since it is provided with blades of different lengths, thus allowing incisions of a depth appropriate to the size of the gland to be attacked. On general principles, this instrument (Fig. 236) consists of a double current tube (through which cold water flows) beaked at its distal end to facilitate its passage into the bladder, provided with a connecting handle and contact screw which allows the current to be turned on and off, and a wheel for the purpose of moving the blade during the operation. To this wheel is attached a scale to denote the length of the incision, also one of a set of four interchangeable galvano-cautery blades so made that they slip snugly into the beak of the instrument.

These so differ in curve as to regulate the depth of the incision. The operation may be accomplished without general anæsthesia, though, as a rule, the administration of nitrous oxide will be found more satisfactory than attempts to subdue pain by local means. There is usually little bleeding and no shock, and the method is applicable to cases complicated by cystitis. In the latter case, however, bladder inflammation may, when it is severe, be treated for some days, especially when complicated by urinary fever. Continuous catheterization may under such circumstances prove needful.

Just before operation the bladder should be irrigated with normal salt solution to which has been added adrenalin chloride in such quantity as to make the solution the strength of 1 to 5000. Thereafter the entire urethra should be instilled with a four per cent. solution of eucaine. One ounce of this solution should be injected into the bladder and allowed to remain for five minutes. The bladder should finally have injected into it four to six ounces of normal salt solution containing 1 to 5000 adrenalin chloride. This with the eucaine solution should be allowed to remain till the completion of the operation. The instrument should be tested immediately before its introduction. The patient is then placed in the perineal position with the pelvis elevated, the instrument is passed until its beak lies within the bladder, the index-finger of one hand is passed into the rectum and the beak is rotated downward until it is felt by this finger that the blade is so placed as to

FIG. 236.



Young's galvano-cautery prostatic incisor.

provide for division of the prostate without injury to the rectum. If the obstruction is due to the median lobe, this should be divided first, the beak being hooked against the prostate and the obstructing portion being fitted into the angle formed by the beak with its staff by the rectal finger. The current is now turned on, and when the time previously estimated as sufficient for producing a white heat in the knife has elapsed, the wheel of the handle is turned, drawing the blade forward at the rate of half an inch a minute. This cutting having been completed, the knife is returned to its position in the beak by reversing the motion of the wheel. The current is then shut off and the knife allowed to cool, after which it is placed in position for a second incision. Usually three incisions are employed, one for the median lobe and one for each lateral lobe. The lateral cuts should usually be deeper than the posterior one. This requires a change of blades. The length of the incision is usually from one to one and a half inches. Following the operation the bladder is thoroughly douched with a normal salt solution containing adrenalin, and continuous catheterization is employed, since acute retention incident to œdema is a common sequel. Continuous catheterization is applicable for three to five days together with the administration of urinary antiseptics. In the second week sloughs are usually passed with the urine, the latter becoming clear. Irrigations are continued. Instillations of silver solutions into the prostatic urethra are serviceable in hastening the healing of granulating surfaces, and the passage of full-sized sounds is indicated to prevent cicatricial contracture.

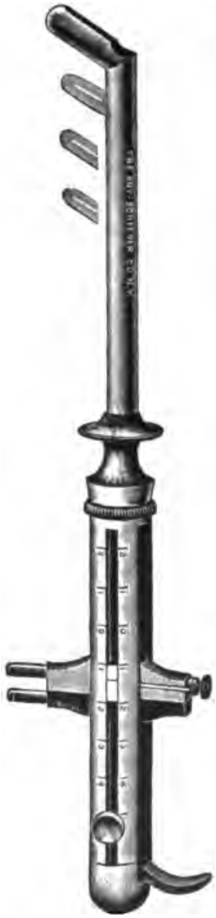
The urethral galvano-cautery operation is open to the objections that valve-like or pedunculated growths either escape the instrument, are imperfectly removed, or may be left in the bladder as foreign bodies; that during convalescence the suffering from vesical tenesmus is at times extremely severe, that secondary hemorrhage, pelvic phlebitis, and urinary extravasation are occasional sequels, that residual urine is likely to remain, and that the procedure has at times been followed by incontinence.

The mortality is given by Watson as six and three-tenths per cent. Basing his conclusions on Meyer's statistics, he notes twenty-two per cent. of cases associated with serious or annoying complications, and thirteen per cent. in which the operation had to be repeated. Incontinence of urine developed in thirteen and six-tenths per cent. and the operation failed in eleven and six-tenths per cent. Of four hundred and ninety reported cases about one-third were cured.

GALVANO-CAUTERY PROSTATOTOMY THROUGH A PERINEAL OPENING.— Chetwood has suggested galvano-cautery incision through a perineal opening. His instrument (Fig. 237) resembles that devised by Bottini, but the blade is drawn out by a direct pull to a stop-pin which is set at the desired point. The results are verified by digital exploration. Moreover, complications may be more readily treated and the danger of urinary extravasation from an incision carried into the membranous urethra is entirely obviated. The thorough exploration allowed by the perineal opening, enables the surgeon to proceed at once to a complete prostatectomy in case this be deemed advisable.

Perineal section is performed and the urethra is opened transversely at the apex of the prostate. By digital exploration the exact condition of the gland and the bladder is determined, and the length, depth, and location of the incisions are estimated. The blade for the cut is then selected, put in the staff, and the stop-pin is put in position on the handle. The instrument having been tested is introduced through the urethral wound. With the index-finger in the rectum, the beak is made to hug snugly against the obstruction, the current is turned on, and after the required number of seconds as previously determined to produce white heat, the handle is slowly pulled out to the stop-pin, the blade is then slowly returned to its position in the beak, and the current is turned off. The rate of cutting should not be more than half an inch per minute. Burning of the bladder is avoided by a stream of cold salt solution running through the urethra and into the perineal wound. After operation the bladder is irrigated, the perineal drainage-tube is secured in place, and treatment thereafter is that indicated after perineal prostatectomy.

FIG. 237.



Chetwood's galvano cautery prostatic incisor.

Bouffleur has modified the galvano-cautery operation by performing it through a suprapubic cystotomy incision, using the actual cautery heated to white heat. The incision is thus made directly under the guidance of the eye and finger.

PROSTATECTOMY.

Total removal of the gland is indicated in all cases of pronounced enlargement with symptoms of progressively increasing urethral obstruction. The softer and larger the gland the easier and safer, as a rule, is the operation. Small dense fibroid prostates, particularly those which are the seat of chronic inflammation, are least amenable to this treatment, the difficulties of removal being great and the operative sequelæ being frequently unsatisfactory.

The gland may be removed through a suprapubic opening, the operation being conducted mainly by the guidance of touch; through a small vertical perineal opening, the operation being conducted entirely by the guidance of touch; or through a transverse curved perineal opening, the operation being directed by both the senses of touch and sight.

Prostatectomy is the procedure of election when operative interference is indicated, when the kidneys are competent or can be made so by appropriate treatment, and the patient's general condition is such as to enable him to endure a major operation. The operation should be delayed in the presence of severe acute infection, either local or constitutional, until by diet, urinary antiseptics, systemic treatment and drainage, and irrigation of the bladder this condition is bettered. This drainage is most easily employed in the form of continuous catheterization. Where this is not applicable, suprapubic or perineal drainage may be secured in a few minutes by means of either local anæsthesia, or, better still, the administration of nitrous oxide.

As to the choice of operation, it is apparent that by either route the great majority of prostates can be removed. The small sclerosed prostate, the capsule of which is densely adherent to the fibrous sheath, can probably be most safely reached and enucleated through a transverse perineal opening. Soft fibro-glandular prostates, the lobules of which are readily shelled out from the surrounding stroma and the lobes of which are easily enucleated from the investing sheath, can be readily and safely enucleated by any one of the three methods.

In general terms, when there is a narrow, deep perineum, a greatly elongated urethra, and the prostatic enlargement is placed so high as to be reached with difficulty by rectal examination, the suprapubic operation would seem indicated. The experience and aptitude of the operator with the method to which he is accustomed is of far greater importance in determining the choice of procedure than the character of the prostatic enlargement.

Suprapubic Prostatectomy.—The transvesical route has been popularized in England by Freyer, who, adopting the technique of Fuller, has obtained admirable results. In this country the perineal operation is the more popular, since it is attended by a distinctly lower mortality, and since it enables the surgeon to remove practically all the prostate and spare the prostatic urethra. The removal of this latter tube, however, seems to have no evil effect upon the ultimate result.

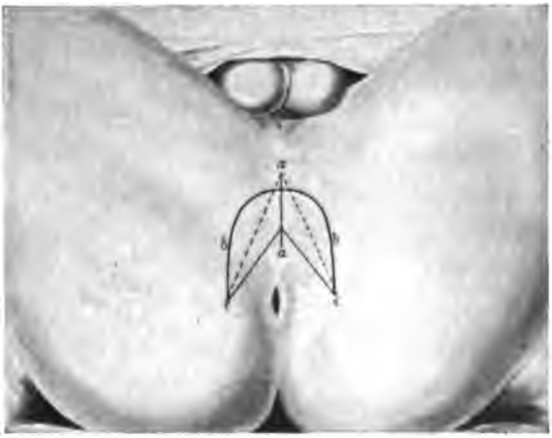
On general principles, the suprapubic operation is somewhat easier for the removal of large intravesical growths or pedunculated lobes. Moreover, this method enables the surgeon to explore the bladder thoroughly both by sight and touch. Impotence, permanent urinary incontinence, and urinary fistulæ are rarer sequelæ of this operation than of the perineal incision. In very fat persons and in those with extremely contracted bladders, the suprapubic operation is to an extent contra-indicated.

The position of the patient during the performance of this operation should be that for suprapubic lithotomy. The instruments required are scalpels, hæmostats, tissue forceps, retractors, curved and straight needles, ordinary straight and curved scissors, silkworm gut, polyp or prostatic grasping forceps, sounds, rubber catheters, an irrigator, and a siphon drainage apparatus.

Immediately before operation the bladder is irrigated with protargol solution 1 to 2000, from six to twelve ounces of which are left in the bladder, according to its capacity. The patient in the dorsal decubitus is elevated to the Trendelenburg position, and an incision is made directly in the median line, beginning at the symphysis and extending upward two inches. In fat people the incision is lengthened upward through the subcutaneous tissue. The sheath of the rectus and the layer of transversalis fascia bounding the anterior surface of the prevesical space are cut through, thus exposing the bladder and the fatty tissue and venous plexus overlying it. An incision is made in this fatty tissue in such a way as to avoid the large veins, and the bladder-wall is exposed and held up by a silk suture passed by a curved needle across the middle of the proposed vesical incision. The division of the bladder-wall is made by an inch cut midway between entrance and the exit of this suture, the mid-portion of which is pulled through the wound and divided, thus leaving a thread retractor on each side of the wound. The fluid contents of the bladder are then entirely removed either by suction or sponges, allowing the interior of this viscus to be thoroughly inspected, a small electric light rendering this part of the examination easy. The prostate should be made prominent by the finger of an assistant in the rectum. The vesical orifice is located by means of a catheter passed through the urethra. The thin bladder-wall over the projecting lobe is cut for half an inch to an inch by means of long handled straight scissors, the incision being placed a little to the side of the urethral orifice and just back of it. The finger is then passed through this opening and carefully strips off first the mucous membrane of the bladder and then the prostatic sheath from the capsule of the gland. It is important in this enucleation to keep the finger close to the capsule and not to allow it to tear the fibrous investing sheath in which lie many large veins. This plexus is particularly well developed at the sides and the anterior surface of the prostate. When the lobe is partly free its further enucleation may be facilitated by seizing its end in broad traction forceps and drawing upon it while the finger strips it of adhesions. It is sometimes possible to enucleate the entire prostate in one mass. In this case it is probable that the prostatic urethra comes with the gland. Usually two lateral lobes are removed separately. The central lobe or commissure may be attached to one or the other. In many cases the prostatic urethra is often extensively lacerated or may be removed entirely. There seems reason to believe that it is sometimes left intact, but necessarily with some prostatic substance. In the dense small prostates, total removal of the gland will be quite impossible without producing extensive tears of the investing fascia. Under such circumstances the prostate should be removed piecemeal by an appropriate cutting and pinching instrument. This procedure is distinctly less serviceable than total enucleation. The catheter lying in the bladder guides the surgeon as to the position of the prostatic urethra, which should be preserved if possible. During this operation there is sometimes profuse hemorrhage due to tearing of the investing fibrous tissue. It is best checked by firm pressure made with packing soaked in adrenalin solution 1 to 5000. Exceptionally, it is needful to make a free opening and apply hæmostats. The patulousness of the urethra is determined by a full-sized rubber catheter which is allowed to remain for drainage. The operation is completed by thorough irrigation of the bladder and fairly close suture of the walls of this viscus around a suprapubic drainage-tube which should be attached to a siphon apparatus. (See page 480.) The parietal wound is closed with tube or wick drainage of the prevesical space. There is always some postoperative bleeding lasting one or two days; as a rule, moderate in degree, very exceptionally profuse, and resulting fatally.

Prostatectomy by Median Perineal Incision.—This operation is particularly indicated in large soft prostatic overgrowths extending toward the rectum. It is practicable, however, to make a complete operation, even though the direction of growth be distinctly intravesical. The dense fibrous sclerotic hypertrophy in which the capsule of the gland is likely to be closely adherent to the periprostatic sheath is more readily and safely removed by a transverse perineal incision under the guidance of the eye and finger. The patient is placed in the lithotomy position, and after the customary cleansing of the bladder a grooved staff is passed and an incision is made from the scroto-perineal junction to within half an inch of the anus directly in the middle line. (Fig. 238.) This incision is deepened, dividing the perineal centre until the membranous urethra is exposed. This is incised, the cut passing back through the lower part of the prostatic urethra, and the finger is introduced through the prostate into the bladder if this be possible. The opening is sufficiently dilated to allow the introduction of the blade of a pair of scissors, by which means a transverse incision is made in the urethral floor at or a little back of the apex of the prostate. (Fig. 239.) The finger is then introduced into this incision, working its way between the capsule of the gland and the outer fibrous investment. Young's tractor (Fig. 246) will be found serviceable in separating the posterior portion of the lateral lobes and the large middle lobe, or these portions of the gland may be made accessible by a finger in the rectum. Guiteras advises the use of a prostatic elevator shaped somewhat like a stove-lid lifter. When the gland is sufficiently loosened its anterior part is seized with forceps and drawn out, thus allowing more ready separation of the deeper parts. This operation, if conducted with care, is attended by little bleeding and does not seriously endanger the rectum. It is rapid, but is more likely to secure enuclea-

FIG. 238.

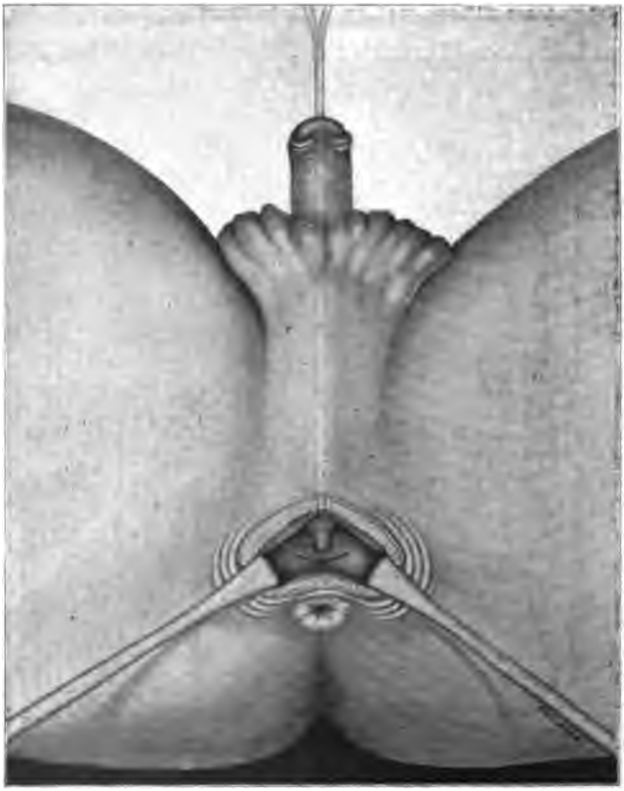


Various perineal incisions.

tion of enlarged lobules than of the entire gland, unless the prostatic urethra is also sacrificed. Removal of the middle lobe may be extremely difficult, though this usually comes out with one or other of the lateral lobes. It is conducted entirely by the sense of touch.

After removal of the prostate, the bladder and prostatic bed are thoroughly irrigated, a large perineal drainage-tube is introduced, and the parietal wound is closed by suture. (Fig. 252.) The bladder is irrigated twice daily with protargol solution 1 to 2000 for a week, after which the drainage-tube is substituted by a large catheter passed through the entire urethra into the bladder and allowed to remain until the perineal opening is fairly well closed in. This operation is distinctly contra-indicated in hard, small glands closely attached to the fibrous capsule.

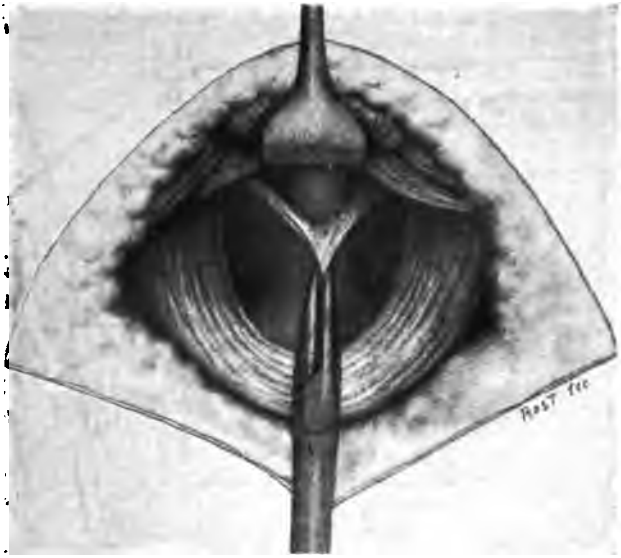
FIG. 239.



Prostatectomy through retracted edges of median incision. (Ferguson.)

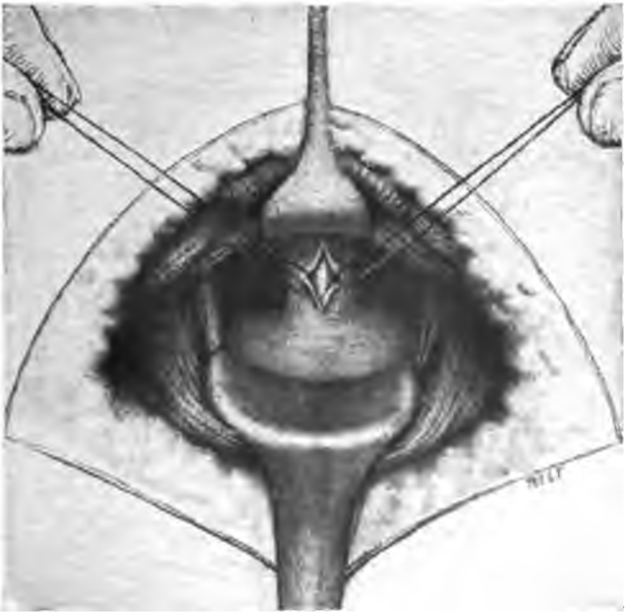
Perineal Prostatectomy by Transverse Incision.—The patient having been placed in the exaggerated dorsal perineal position,

FIG. 240.



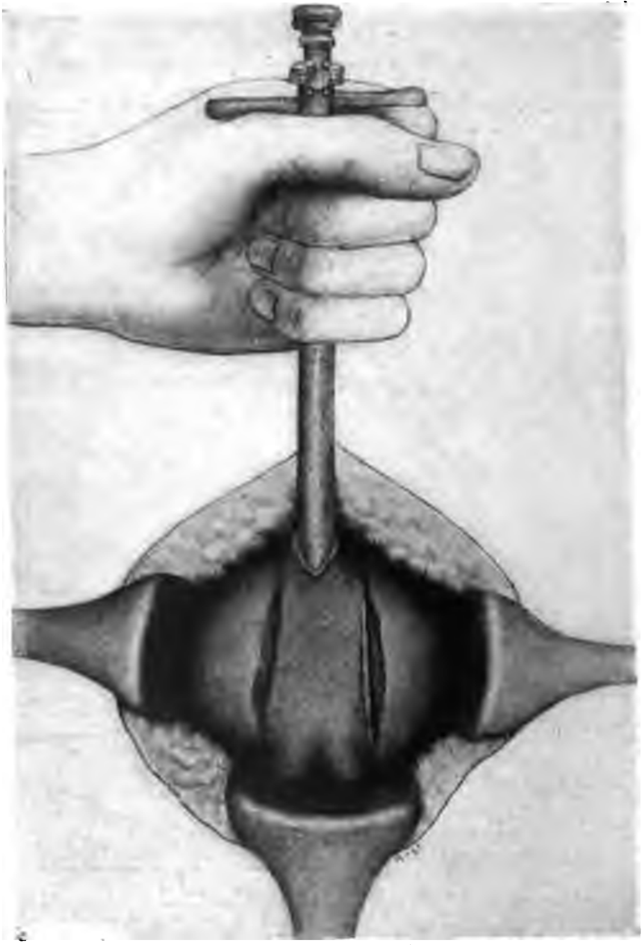
Exposure of membranous urethra after division of recto-urethralis. (Young.)

FIG. 241.



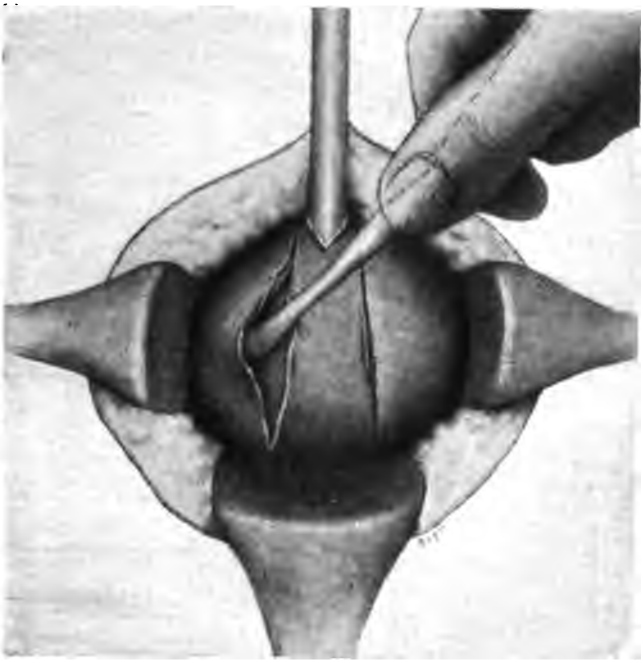
Opening of urethra on sound, preparatory to introduction of tractor. (Young.)

Fig. 242.



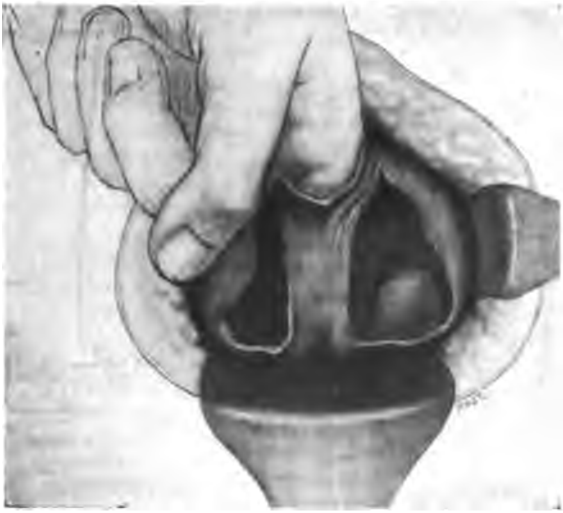
Tractor in position, blades separated, prostate pulled down, posterior surface exposed. Incisions in capsule on each side of ejaculatory ducts. (Young.)

FIG. 243.



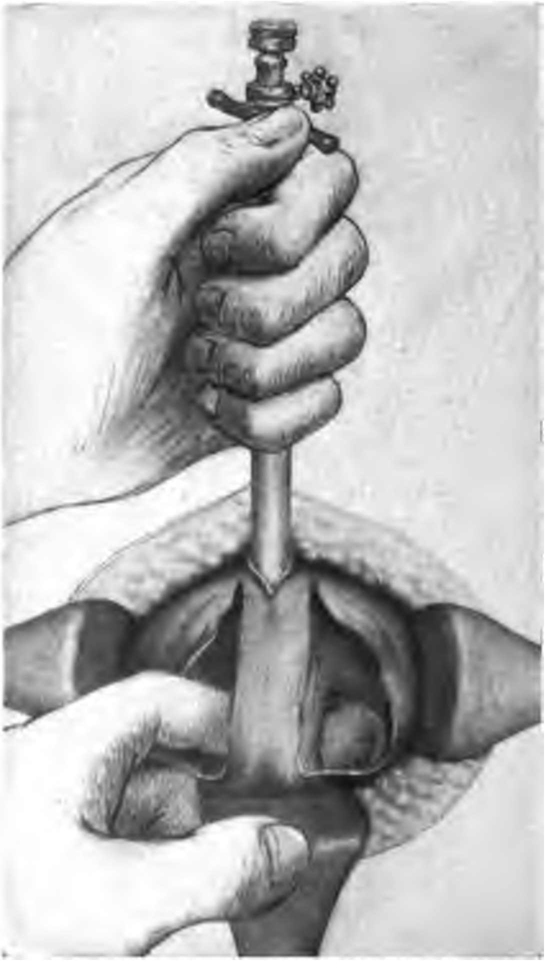
External enucleation begun. (Young.)

FIG. 244.



Delivery of a small median portion into lateral cavity by use of finger instead of tractor. (Young.)

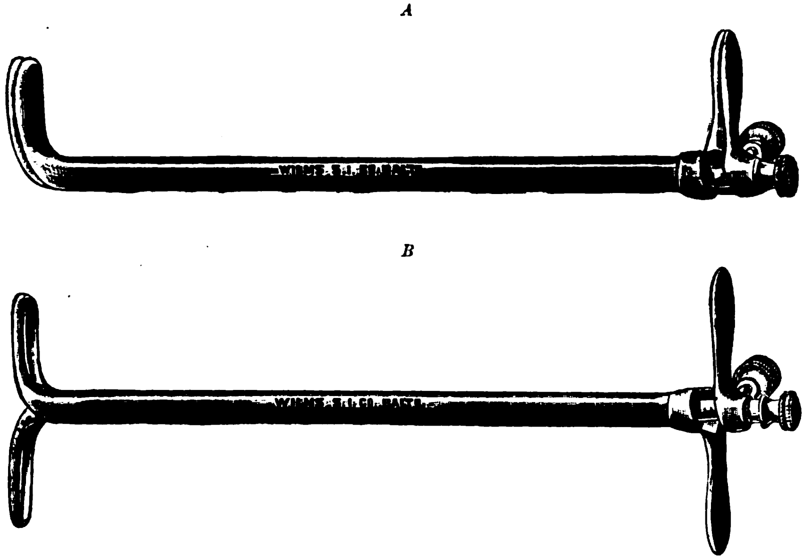
FIG. 245.



Delivery of median portion into lateral cavity. (Young.)

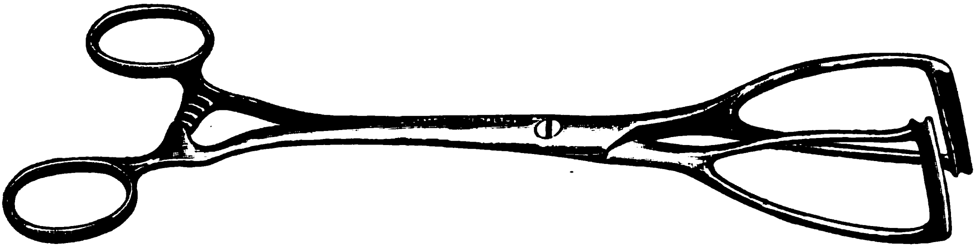
by strongly flexing the thighs on the body, supplemented by securing anterior curvature of the lumbar spine by means of a high cushion placed beneath the sacral region, a staff is placed into the bladder and the scrotum and penis are held well up by an assistant, thus drawing the bulbous urethra well up toward the symphysis. The incision should be convex, starting midway between the anus and the ischial tuberosity of one side, swinging forward to a point just behind the perineo-scrotal junction and around to a point on the other side corresponding with its beginning. (Fig. 238.) The operator divides the skin and superficial fascia, the central tendon of the perineum, the recto-urethral muscle, and the transverse perinei muscles as well as the tri-

Fig. 246.



Young's prostatic tractor. *A*. Closed. *B*. Open.

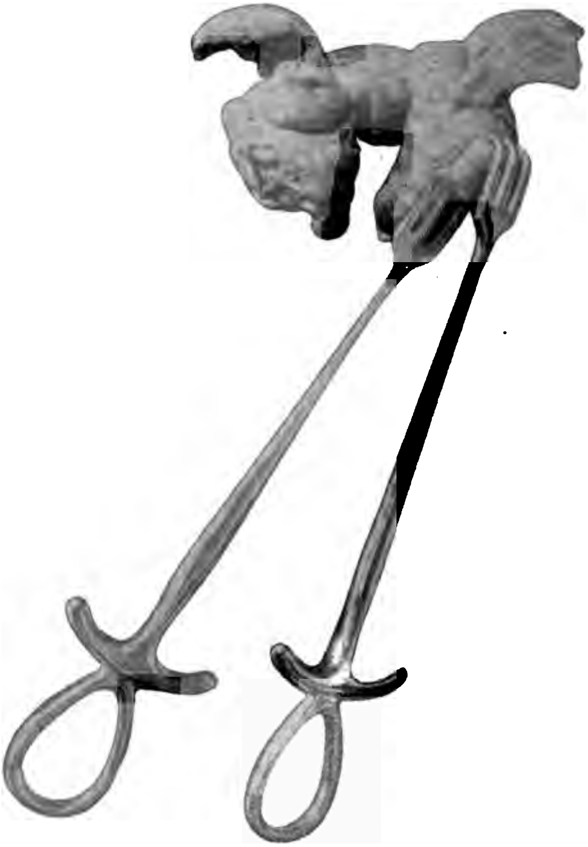
Fig. 247.



Young's lobe forceps.

angular ligament. The central tendon is divided close to the bulb, thus freeing the anterior attachment to the sphincter ani muscle. By division of the recto-urethral muscle the anterior support of the rectum is removed, allowing the latter to be held out of the way by a broad retractor. (Fig. 241.) The bulb is retracted forward and the lateral edges of the wound are drawn to the sides by deep narrow retractors, thus exposing the membranous urethra and the fibrous sheath of the prostate lying between the two levator ani muscles and partly covered by them. The levator ani are pushed aside by blunt dissection and held out of the way by the deep lateral retractors. The prostatic sheath is then divided longitudinally on each side of the urethra as suggested by Young, leaving between a bridge of tissue, (Fig. 242) in which lie the ejaculatory ducts, the sinus pocularis, and

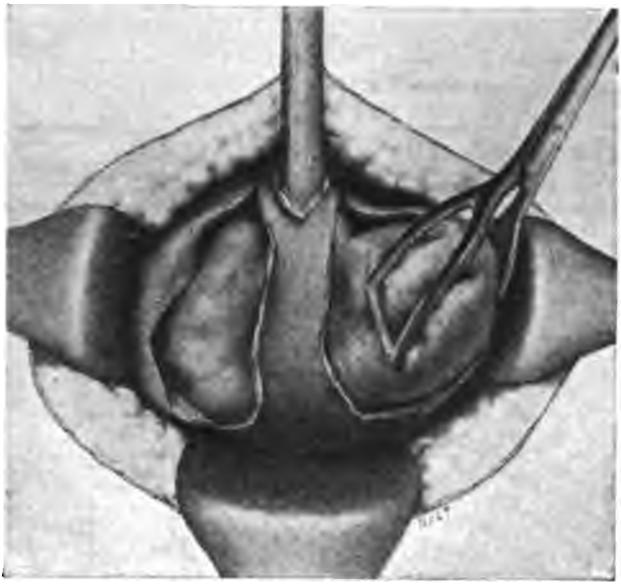
FIG. 248.



Murphy's hooks.

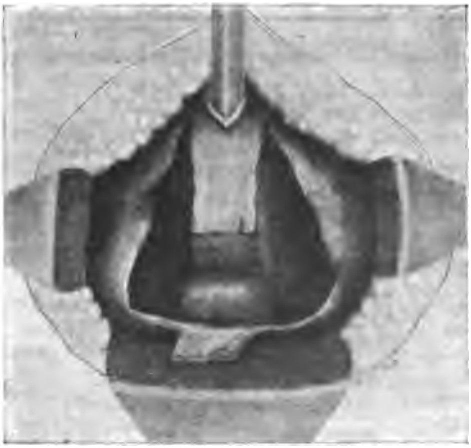
the prostatic urethra. This incision should be carried through the outer fibrous sheath and down to the fibrous capsule proper, and usually from one-quarter to half an inch in depth. The fibrous sheath over each lobe is then partly separated from the capsule of the gland by the finger or a blunt dissector beginning at the line of incision and

FIG. 249.



Enucleation of lobes. Forceps in position. (Young.)

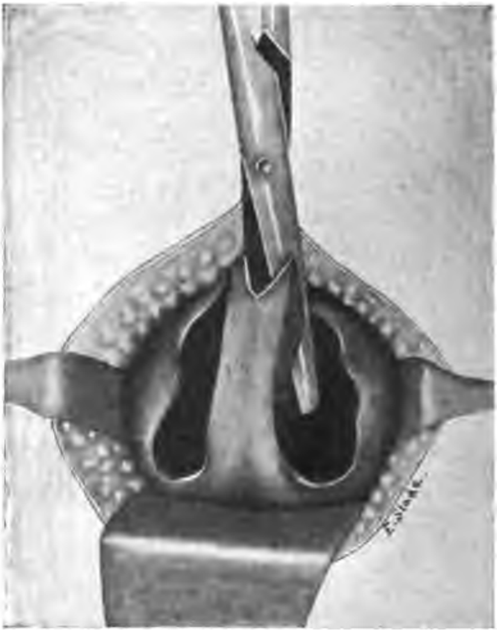
FIG. 250.



Suburethral method of enucleating median bar. (Young.)

proceeding laterally and upward towards the bladder. (Fig. 243.) When separation is sufficiently advanced, the long lateral retractors should be placed within the separated sheath, thus giving the freer exposure and making more accessible the prostate itself. At times, by means of tenacula and forceps, enucleation can be rapidly completed. Usually, it is necessary to bring the gland still further in reach, and this may be best accomplished by Young's tractor. This instrument is introduced through an incision into the prostatic urethra as near the apex of the gland as possible. (Fig. 242.) This incision should be sufficiently large to introduce the index-finger, which, by dilating the prostate, is passed into the bladder. By means of the finger the deeper parts of the gland may be made so accessible that complete removal is easily accomplished. (Fig. 244.) If, however, the mass is still inaccessible, Young's prostatic tractor is introduced closed, its blades are then opened, and the gland is delivered into the wound by upward traction made by an assistant. (Fig. 245.) It should be remembered that the fibrous sheath or false capsule of the prostate may exhibit in itself a line of cleavage between its layers, and if the operator be misled by this into the belief that he

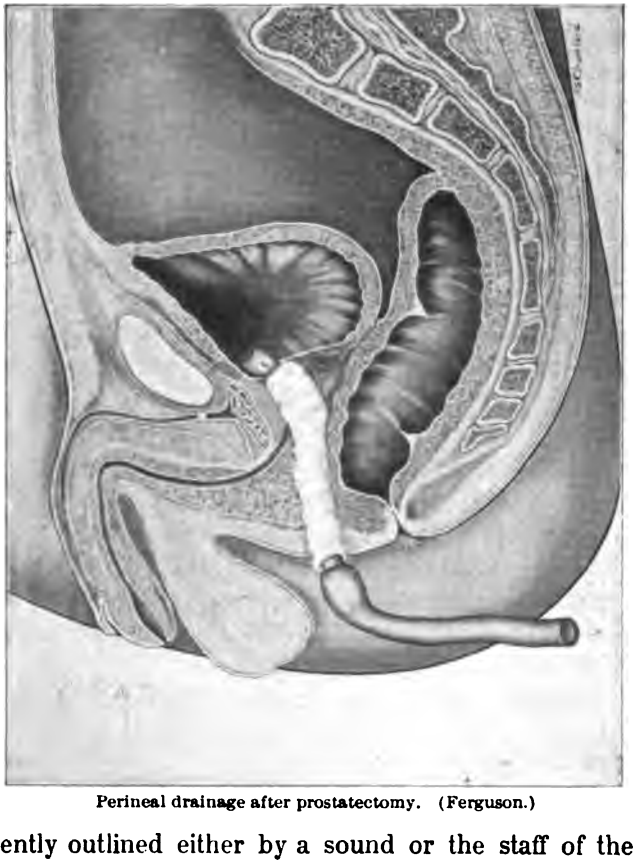
FIG. 251.



Division of lateral wall of urethra to allow extraction of large calculus through lateral cavity. (Young.)

has reached the true capsule, he is in grave danger not only of producing lesions of the bladder and rectum, but of causing severe hemorrhage. If the true capsule is penetrated and separation is begun in the gland substance, imperfect removal will result, the gland coming away piecemeal. Where morcellement—*i.e.*, piecemeal destruction—is necessary, it is best accomplished by Ferguson's forceps. Special care is taken to avoid wounding the urethra, which is sufficiently outlined either by a sound or the staff of the tractor. A full-sized drainage-tube is passed through the urethral opening, its orifice lying just within the grip of the internal sphincter, after which the bladder is douched with protargol solution. The cavity left by the removal of the prostate is lightly packed with gauze, the incision in the soft parts is closed by buried chromicized catgut sutures, a sufficient opening being left in the skin incision to allow of drainage. The perineal drainage-tube is removed in about ten days, after which continuous catheterization is employed for a week.

FIG. 252.



Perineal drainage after prostatectomy. (Ferguson.)

The Results of Prostatectomy.—The removal of the prostate, if skilfully conducted and in properly selected cases, affords a permanent cure of urinary retention in the great majority of cases, and, moreover, produces a peculiarly regenerating effect upon the cases subject to operation. Enucleation may be extremely easy, being accomplished in a few minutes or may be impossible of accomplishment in the hands of the most skilled. Thus, Albarran notes that enucleation was easy in twenty-nine cases, difficult in seven, and impracticable in three.

The mortality of the operation varies somewhat according to the procedure adopted.

Transvesical prostatectomy is generally regarded as more lethal than the perineal operation. Watson gives a mortality of eleven and three-tenths per cent., almost double that of the perineal operation. Escat notes thirty-one deaths in one hundred and sixty-four cases (eighteen per cent.). Freyer, whose statistics are among the best, gives a mortality of ten and ninety-five one hundredths per cent. Hemorrhage, shock, uræmia, and infection were the prominent causes of immediate mortality. Pelvic abscess, calculus formation, reopening of the suprapubic wound, and stricture were noted as remote sequelæ.

Total perineal prostatectomy gives a mortality of six per cent. (Proust, seven hundred and twenty-four cases; Watson, five hundred and thirty cases), and from the statistics of individual operators of from three to six per cent., though Rochet records a mortality of eleven and three-tenths per cent. Complications which are comparatively frequent are orcho-epididymitis, fistula, incontinence of urine, stricture, and pulmonary embolus. There is sometimes trouble in defecation, either incontinence or coprostasis. Petit reports twelve cases of orcho-epididymitis in thirty-eight cases, and Rafin eight in twenty-four cases. It is sometimes double, and is not absolutely prevented by ligature of the vas deferens.

Watson notes urethrorectal fistulæ in two and seven-tenths per cent. of five hundred and thirty cases. Escat notes in three hundred and eighty-two cases a percentage of fistulæ nearly twice as great. This constitutes a serious, at times a fatal, sequel to operation. Incontinence following perineal prostatectomy is usually transitory, though its persistence has been observed for two years.

Watson records pulmonary complications, such as embolus, pneumonia, and congestion, in seventeen per cent. of cases.

Impotence is the almost invariable sequel of perineal prostatectomy, though there is reason to believe that the saving of a central bridge of tissue containing the ejaculatory ducts (Young) may leave the genital functions intact.

Castration and Vasectomy.—One of us (White) (*Annals of Surgery*, Dec., 1904) has recently summarized as follows the history of these operations and his personal views in regard to them: Probably most surgeons would to-day dismiss castration and vasectomy from consideration as summarily as I have rejected interstitial injection or transrectal galvanism. It may be that they are entirely right. It was in an address before the American Medical Association, 1893, that I first suggested castration as a possibility in the treatment of prostatic hypertrophy. Ramm, of Norway, appears to have had the same idea at about the same time, but to have published nothing until later. Doubtless others had thought of it more or less vaguely, but no one seems to have tested its value experimentally as I had done previous to laying it before the profession. I said towards the end of the paper: "I have one further thought to mention to this Association, although I do so with a reluctance born of the fear of being considered illogical or impractical, or perhaps both." I then went on to recall the well-known theory as to the analogy between uterine fibromyomata and prostatic overgrowth, the effect of oöphorectomy on the former, the testimony as to the infantile character of the prostate in the eunuchs, the observations of John Hunter and Griffiths upon the prostates of the mole, the hedgehog, and the bull, and finally described the results of the experimental castration of dogs (Kirby)—with control experiments—in the following words: "These results, which I believe may be relied upon, place beyond all peradventure the influence of castration (in the dog at least) upon the condition of the prostate, and show clearly that the operation is followed invariably, and with a promptness which I must confess was to me surprising, by atrophy first of the glandular and then of the muscular elements, and by a coincident reduction in both bulk and weight." After discussing the possibilty of making these facts a basis for the employment of castration in prostatic hypertrophy, I said: "I do not desire to be understood as insisting upon the truth or even upon the probability of the above hypothesis. I have simply, with much hesitation, determined to follow out publicly a line of thought that had occupied my mind at odd times, and to submit it to your criticism;" and added: "I might admit, finally, that I have not had the courage of my convictions, and have never seriously sought to recommend the operation, but it would be truer to say that I have as yet no definite convictions, and that I am simply seeking enough light upon the subject to convince me either that it is worth pursuing further, or, on the other hand, that it offers no possibility of practical usefulness."

Even with so cautious a presentation of the subject, however, the operation was taken up all over the world with great rapidity, and large numbers of patients were subjected to it, some of them, as the reports show, already moribund. Many cases were operated upon and the immediate results published before I had myself found what I regarded as a case suitable for this procedure.

I had spoken of the operation as one "with a low mortality," and so conservative a surgeon as Lord Lister, in commenting on my paper, remarked that I should have said "with no mortality." I was disappointed to find that a very considerable mortality was reported. It was true that the majority of the deaths were obviously in spite of, not because of, the operation. Still, the death-rate was larger than any one had anticipated. Two years later (July, 1895) I was able to gather from surgical literature and through correspondence a series of one hundred and eleven cases that had been operated upon. The deaths were twenty, thirteen of which I thought should be excluded in an attempt to arrive at the legitimate mortality, as they had occurred in cases that were obviously at the point of death when operated upon. Even with this exclusion—which was not assented to by the critics of the operation—the remaining mortality of seven per cent. was greater than I had anticipated.

A glance at that paper with its table of cases will show apparently (according to the reports of surgeons from all countries in the world) that in about eighty-five per cent. of cases such diminution in size of the prostate had rapidly followed the operation that it was thought to be analogous to, or identical with, the atrophy I had experimentally shown to occur in dogs; that long-standing cystitis had disappeared or greatly lessened in more than half the cases; that distinct amelioration of the most troublesome symptoms had occurred in over eighty per cent. and a return to local conditions not very far removed from normal in forty-six per cent. of those operated upon.

At this time I felt hopeful as to the future of the operation, and defended it to the best of my ability, on the basis of these clinical reports of actual cases. By the end of 1896 I said that I would be quite content if nothing better could ever be said of the operation than Dr. Arthur Cabot (who had been a keen and thoughtful critic from the beginning) said would be justified by the then existing statistics if further experience confirmed them, viz., "We shall be able to express the facts thus to our inquiring patients: You have eight chances in ten of getting through the operation all right, and if you are successful in this, you have again eight chances in ten, or a little better, of getting very substantial relief from your urinary difficulties."

In 1900, Dr. Alfred Wood published a collection of one hundred and fifty-nine cases of castration, and one hundred and ninety-three cases of vasectomy, none of which had been included in my table of 1895, or in Cabot's table of 1896. The reported results of the castrations showed thirteen deaths (a little over eight per cent. of mortality), and with some variations corresponded approximately to the results shown in the earliest table. In the vasectomies the mortality was six and seven-tenths per cent., and in sixty-seven per cent. some form of general improvement was noted.

In the same year (1900) Mr. Reginald Harrison reported more than one hundred cases of vasectomy, and said that he had been able to observe "benefit of some kind and in some degree in almost every case, although the accompanying conditions often prevented anything like a cure."

In 1902, Rovsing reported forty cases of vasectomy, of which twenty-seven were cured, nine relieved, and four unimproved. There were no deaths. He adds: "I should under no circumstances feel myself justified in undertaking the total extirpation of the prostate in a patient in whom I had not done a vasectomy, which in many cases gives such extraordinary relief."

During the decade during which this evidence has been accumulating I have in my own practice—including both private and hospital patients—found but fifteen cases in which I thought castration justifiable, and thirty-seven cases in which I have performed vasectomy. I mention these figures merely to indicate that I have tried to preserve the conservatism with which I suggested the operation originally.

My present opinion is that castration and vasectomy are likely to occupy a more and more restricted field in the treatment of prostatic hypertrophy. In properly selected cases I still think that they are likely to have a low mortality, and that when fully successful they secure a return to a condition more closely resembling the normal than most of the other operations looking towards a radical cure of the hypertrophied prostate. Although in the several hundreds of reported cases the outcome seemed in the majority of instances to be satisfactory to the operators, these procedures have been gradually given up in favor of various others more recently advocated. The uncertainty of their results, both immediate and remote; the fact that they are not free from danger; and, so far as castration is concerned, the strong and not unreasonable sentimental objections to it, combine to render their final status in the treatment of prostatic hypertrophy a matter of doubt. It may be that a better classification of prostatics in accordance with their clinical history will resolve this doubt.

In the meanwhile, without the least disposition to urge these operations upon the profession, or to claim anything for them which facts do not justify, I would suggest that they still merit at least occasional consideration; that not *all* of the published reports of successes can be inaccurate or misleading; that such testimony as Harrison's or Rovsing's should not lightly be ignored; and that it is quite possible that there may still be a definite field of usefulness for these procedures, although I now believe that it will be much more limited than I at one time thought it would be.

My opinion as to the greatly—and justly—increased limitations of these operations in the future is much influenced by the improvements in the methods of performing prostatectomy.

Cases of death with precedent mental symptoms, described as mania, acute mania, etc., are only such as every surgeon is familiar with in a certain proportion of operations done upon aged persons, whose mental equilibrium is easily disturbed, and can have no bearing upon the question of later mental changes as the result of castration. With greater accuracy we should probably classify the large majority of them as uræmia and some of the remainder as traumatic delirium. Clinical evidence leads to the belief that the removal of the testicles from persons who have reached full adult life, and *a fortiori* from very aged persons, has no effect upon the mental functions or upon the general physical characteristics. Impotence will undoubtedly be caused in the majority of cases, but even this is not immediate or inevitable.

CASTRATION.—The operation of castration has been described already. The patients on whom it is performed for the relief of enlarged prostates are old, feeble, vulnerable, and little fitted to react from any prolonged surgical intervention. Ether should be given to the first stage. An assistant then grasps the scrotum from behind, pressing the testicle forward and making the overlying skin tense. The surgeon makes a three-inch incision, through which the testicle is squeezed by the pressure of the assistant's hand. The gland is grasped, pulled well forward, the ligament attaching the base of the testicle and the epididymis to the scrotum behind is divided with the scissors or knife, the cord is pulled well down, transfixed, ligatured, and divided, the lumen of the vas is touched with a crystal of pure carbolic acid, and the parietal wound is closed by two or three silk or horse-hair sutures, no drainage being employed. Not more than two or three blood-vessels need be secured, and both testicles should be removed in less than five minutes. The wounds are dressed with an abundance of loosely crumpled sterile gauze, secured in place by a crossed of the perineum bandage.

Vasectomy.—The operation possesses the advantages of not requiring ether for its performance, of not exciting the opposition of the patient, and of producing no appreciable deformity. It is easily and quickly done, and does not cause shock. The vas is usually most accessible through the posterior surface of the scrotum. It is isolated from its surrounding veins, and is held in place close beneath the skin, which is stretched tightly over it by the two hands of an assistant, the thumbs and forefingers making firm pressure and holding the vas away from the other structures of the cord. The skin overlying the vas is then infiltrated by Schleich's solution of cocaine and is divided; the fibrous tissue overlying the vas is cut through, the vas itself is isolated and hooked out with a grooved director, is freed for an inch, and a ligature applied above and below, and the portion lying between the ligatures is removed. The wound is closed by a stitch, and the testicle is enveloped in sterile gauze and supported by a crossed of the perineum bandage.

ATROPHY OF THE PROSTATE.

In exhausting diseases accompanied by general wasting of the entire body marked atrophy of the prostate may occur. Thus, Thompson noted one case in which the gland weighed less than one drachm. Extreme old age is usually accompanied by wasting of the prostate; mechanical pressure, as from extravesical tumor or prolonged distention of the bladder, may produce the same effect. The gland may also be partly or completely destroyed by abscess-formation followed by cicatricial contraction and by sclerosis secondary to chronic inflammation. In certain cases the prostate is congenitally atrophied, this condition being generally associated with other malformations. Castration, especially if performed in early life, is always followed by prostatic atrophy, and masturbation, if begun early, and if excessive and long continued, may result in a similar condition. Symptoms of atrophy are practically wanting.

The diagnosis is founded upon rectal examination.

Treatment is unavailing.

PROSTATIC CALCULI.

Thompson has shown that the corpora amylacea are so constantly found in the prostate that their presence can scarcely be considered abnormal. In youth these bodies are usually microscopic in size. Later in life they become larger, so that they are readily seen by the naked eye. The name corpora amylacea is given to them because they exhibit a granular nucleus, probably made up of degenerated epithelial cells and inspissated mucus, about which are formed concentric layers composed of an albuminoid substance the nature of which is not rightly understood, and presenting the microscopic appearance of starch cells.

When the corpora amylacea are small they occasion no symptoms: as they grow larger they act as foreign bodies, exciting inflammation, and have deposited in and upon them the salts of lime, calculi being thus formed. The calculi may lie separately, each in its own pouch, or many of them may be placed in a common pouch, often adherent to one another. In color they are brown or black, with a smooth polished surface, exhibiting facets when a number of calculi are placed together in a single pocket. They are made up of calcium phosphate, calcium carbonate, and organic matter, and are commonly found below the urethra, particularly in the region of the verumontanum. If by ulceration the cavity in which they lie opens into the urethra, and the urine has access to them, its salts will be deposited upon them, causing rapid growth, abscess-formation, and ulceration, usually in the direction of the urethra, sometimes backward towards the bladder, or into the rectum or the perineum.

Prostatic calculi may originate in the substance of the gland as just described, may come from the bladder or the urethra, or may be deposited from the urine in suppurating prostatic pouches.

Symptoms.—Until prostatic calculi of glandular formation open into the urethra, symptoms are usually wanting, the condition not being generally recognized until it is shown by post-mortem examination or operation performed for some other pathological condition. When the calculi begin to grow from deposition of urinary salts, the symptoms of posterior urethritis or of chronic prostatitis develop.

Diagnosis is founded on rectal palpation and urethral examination. These calculi, if of considerable size, can generally be felt by the finger introduced into the rectum. A metal catheter will give a grating sound as it is introduced into the prostatic urethra; urethroscopic examination will bring the concretions directly into view.

Treatment.—It is sometimes possible to remove calculi from a suppurating prostate by the straight or slightly curved urethral forceps. We have removed ten from one patient in this manner, and the patient has remained perfectly well. A perineal urethrotomy affords the safest and best route for thorough removal of these concretions. The median perineal incision gives enough room. Exceptionally, when it is necessary to make a careful exploration of the entire prostate, the semilunar incision in front of the anus is required, the anus with its sphincter and the rectum being carried backward, the prostate exposed, and the calculi freed and removed through the incision. For the very small calculi which pass spontaneously no treatment is necessary other than avoidance of all causes of prostatic congestion, as constipation and alcoholic or sexual excess. When in consequence of prostatic calculi there are harassing pains, undue frequency of urination, retention of urine, or cystitis, we believe that surgical intervention is imperatively indicated.

MALIGNANT TUMORS OF THE PROSTATE.

Carcinoma, when it occurs as a primary tumor, is usually observed after the fiftieth year of life. The majority of the tumors are carcinomatous. Oraison, of fifty-five malignant prostatic neoplasms, notes that forty-eight were carcinomatous and seven sarcomatous, the latter occurring in young subjects.

Albarran and Hallé note fourteen epitheliomatous prostates in a hundred subjects supposed before autopsy to be suffering from simple enlargement; this and the observations of Greene and Brooks strongly suggest that malignant degeneration of the prostate is much more common than either clinical experience or gross pathological examination has heretofore suggested, and may be found in the hypertrophied, the normal, or the atrophied gland.

The malignant infiltration may form masses so small as to be detected only on microscopical examination, or great masses rapidly infiltrating the pelvis. As a rule, the growth is small, progresses slowly, and is found towards the rectal surface of the parietal lobes. Even though the prostatic invasion be so slight as to excite no clinical symptoms, it may occasion metastases particularly in the bones, the lumbar vertebræ being those of predilection. In about half the cases there is ultimately local extension, and glandular involvement takes place in fifty per cent. (Kaufmann) of cases, the iliac and inguinal being those chiefly affected.

Symptoms.—These at the time when operation may be curative are identical with the symptoms due to the commonly associated prostatic hypertrophy except that pain seems a prominent feature of many reported cases. On rectal examination tenderness may be elicited, and nodular, densely indurated, tender areas may be found.

When the disease is well advanced, distinct losses or involvement of the periprostatic tissue, extensive infiltration of the pelvic nodes, fixation of the rectal mucosa with shot-like nodules found in it, hæmaturia, especially initial and terminal, and cachexia sufficiently denote both the diagnosis and the inadequacy of any surgical treatment.

Diagnosis.—This is most often suggested at an early stage by the discovery of one or more hard tender nodules in a prostate which before the development of retention causes an unusual amount of pain uninfluenced by the act of micturition. Later, initial and terminal hæmaturia and rapid nodular enlargement are characteristic.

Treatment.—Operation, if performed early, before metastases have developed or the disease has invaded the surrounding structures, gives a large percentage of cures. Oraison reports twenty-three cases; four died from operation, ten remained free from recurrence for over four years, and three suffered from recurrence. The remainder recovered, but their subsequent histories could not be obtained. (Hawley.) The disease may remain strictly localized for a long period. Total prostatectomy, including the prostatic urethra, seems the method of choice. When the paraprostatic tissues are involved, the pelvic lymph nodes are infiltrated, or bone metastases have developed, radical operation is futile. Under such circumstances effort is directed towards relief of the retention of urine, the alleviation of the accompanying cystitis, and mitigation of the pain. Retention of urine should be relieved by intermittent or continuous catheterization. Should this cause severe bleeding, suprapubic incision and drainage are indicated. The cystitis is best treated by suprapubic drainage and antiseptic irrigations. The pain is controlled by opium and morphine administered by the rectum or hypodermically.

Cysts of the Prostate.—Cysts of the prostate are either hydatid or retention. The hydatid cysts are so extremely rare that symptomatology based on clinical experience can scarcely be formulated. The symptoms would naturally be dependent on interference with micturition or defecation, and pain.

The detection of a fluctuating, non-inflammatory tumor would lead to a diagnosis.

Retention cysts are frequently associated with hypertrophied prostates, but in any case are rare. Usually they are due to obstruction of the prostatic follicles. Exceptionally the cyst may be due to narrowing or obliteration of the opening of the utricle. In this case interference with micturition might readily occur. Englisch found five examples of this affection out of seventy post-mortem examinations of newly born children.

The treatment is puncture through the perineum, evacuation, and drainage.

CHAPTER XXI.

SEXUAL WEAKNESS AND STERILITY.

THE term impotence implies a lack of ability to perform the sexual act. It is not necessarily associated with sterility, nor is a sterile person necessarily impotent. Thus, patients whose ejaculations are premature and whose erections are feeble or wanting, though unable to have sexual relations, may discharge semen swarming with living spermatozoa; while those who are particularly vigorous in sexual congress may have no emissions, or may emit fluid entirely devoid of living spermatozoa.

Impotence in the male may be due to congenital or acquired deformity or to feebleness or deficiency in erection.

MECHANISM OF ERECTION.—In the ordinary condition of the penis the muscular fibres lining the trabeculæ are in a condition of tonic contraction: hence the spaces are obliterated. Moreover, the arteries are so contracted that no more blood is furnished than is sufficient for the nourishment of the parts: hence circulation is carried on as in other parts of the body. When the impulse is sent out from the erection centre the arteries dilate and the muscular structure of the erectile tissue relaxes: hence there are provided an increased blood-supply and spaces for its accumulation. At the same time, as a result of muscular contraction, the veins carrying the return blood are pressed upon and congestion is thus increased. As a result the erectile tissue becomes turgid, and this in itself adds to the tendency to engorgement, since the fibrous investment of the penis is put upon the stretch, and thus the venous return is materially interfered with. As the penis becomes tense and rigid it is mechanically carried upward to an elevation of about forty-five degrees by the action of the suspensory ligament, though both the erector penis and the accelerator urinæ, by drawing downward and backward upon the organ behind the position of this ligament, assist in maintaining this position. Erection is finally completed by the active participation of the perineal group of muscles. The erector penis, the accelerator urinæ, the transversus perinei, and the compressor urethræ by tonic contraction with clonic accentuations, materially increase the venous congestion.

With all the factors described in harmonious action, the penis becomes fully erect; its hardness is dependent upon the amount of engorgement and the density of its fibrous investment; the spongy body and the glans are never as hard as the cavernous bodies.

As the result of sexual excitement coincident with erection, the testicles are drawn close to the abdomen by contraction of the dartos and of the muscular fibres of the cord. It is probable that the spermatozoa which fill the epididymis are rapidly carried by the peristaltic action of the muscular coat of this tube and of the vas to the ampulla, from which dilatation, the ejaculatory duct being patulous, spermatozoa are driven into the prostatic urethra. In the mean time, as a result of the active congestion, the mucous glands and follicles of the urethra have been secreting a clear, slightly alkaline, viscid mucus, the possible purpose of which may be the neutralization of any acid urine which may remain in contact with this tube. At the time of orgasm the muscles of the prostate vigorously contract as the compressor urethræ muscle becomes relaxed: thus not only the spermatozoa and the contents of the seminal vesicles, but also the prostatic secretion, are driven forward into the bulbous urethra, being prevented from going back into the bladder by the congestion of the erectile tissue of the verumontanum and also probably by contraction of the internal sphincter of the bladder. Once in the bulbous urethra, the semen is driven forward by contraction of the whole perineal group, aided by the muscular fibres of the urethra.

The semen is a composite fluid, made up of the secretion of the testicles, seminal vesicles, prostate glands, Cowper's glands, and the urethral crypts and follicles. It is a gray fluid, becoming gelatinous on ejaculation. If allowed to stand it becomes thin, and there settles from it an opaque deposit, made up of spermatozoa, over which lies a layer of about equal thickness of gray, translucent liquid. The characteristic odor of semen is probably given to it by the prostatic secretion. It resembles that of a raw potato. Spermatozoa at the time of ejaculation and for about twenty-four hours afterwards, if evaporation is prevented, should be in active motion. When the semen is deposited in the female genital tract, spermatozoa live for many days. After standing for two or three days, healthy semen deposits the spermatic crystals. The amount discharged at one orgasm is from one to two drachms, though this quantity is subject to marked variations.

The nerve-centres for erection and ejaculation are situated in the lumbar cord, the fibres passing outward from the erector centre being termed nervi erigentes.

The erector centre may be stimulated by reflexes from the genitalia or from regions associated by nerve anastomosis, by the direct action of the brain, or by injuries or diseases of the spinal cord. Familiar examples of erection from reflex action are afforded by the morning priapism incident to a full bladder; by the continued erection sometimes associated with prostatic calculus or with inflammation of the posterior urethra; and by the tendency to local congestion exhibited with balanoposthitis. The effect of sights, sounds, odors, or mental conceptions upon the erector centre is too well known to require comment. After fracture of the lower dorsal spines priapism may last for weeks.

Before considering the question of impotence it is well to know what constitutes an average amount of sexual strength. A man between his twentieth and fiftieth year, who has no drain upon his system, such as is required by unusual business anxieties, or such as results from grief, disappointment, etc., should be able to have intercourse about twice a week without experiencing any sense of fatigue or exhaustion. Idiosyncrasy, surroundings, or habits of life may so affect the individual that a much more moderate indulgence would be hurtful. Thus those of lowered vitality from excessive work, deficient food, or organic or functional diseases may find indulgence to the extent above given highly injurious or even impossible, while the vigorous, full-blooded man, whose life is spent mainly in the open air, may far exceed this limit. The gauge as to the healthful limit of intercourse should be the sensations experienced afterwards. These should be rather of increased power, both physical and mental, than of exhaustion.

Erections may take place shortly after birth. The power usually departs about the sixty-fifth year, though it is often retained ten or fifteen years longer; it may be lost as early as the fiftieth year.

From a clinical stand-point impotence may be classified as follows: (1) organic impotence; (2) psychical impotence; (3) atonic impotence.

Organic impotence implies the existence of appreciable lesions which interfere with function. These may involve the spinal cord, producing sclerotic changes either in the lumbar centres or in their afferent or efferent nerve-fibres. Thus, in lumbar ataxia, in syphilis of the cord, and in some cases of myelitis, impotence is sometimes an early symptom of the nerve-affection. This is comparatively rare.

The majority of cases of organic impotence depend upon malformation of the external genitals. This malformation may affect the penis, the testicles, both these organs, or the surrounding parts. The penis may be absent, may be rudimental, may be deformed, may be hypertrophied, may be multiple. If the organ is absent or exists simply as a rudiment, cure is hopeless. If the mechanical impediment to coitus is dependent upon the small size of a penis which is normal in other respects, the case is not beyond help, since it has been shown in several instances that use has been quickly followed by an increase in growth. Thus, Wilson observed a man of twenty-six years whose penis before marriage was not larger than that of an eight-year-old child. Two years after marriage this organ had reached its normal size. In the treatment of impotence in patients with organs perfectly formed but markedly undersized, the application of a suction apparatus may be beneficial. This consists of a cylinder which is fitted over the penis and from which the air can be exhausted; as a result there is venous congestion, with temporary increase in the size of the organ. It is stated that this increase will become permanent if the treatment is continued a sufficient length of time.

The abnormal size of the organ may be an impediment to coitus, but only relatively so. Sometimes the penis is congenitally adherent to the scrotum, or is fixed to the groin or the belly as the result of cicatricial contraction. Here plastic operations will be necessary, according to the special indications of the case.

Hypospadia is a frequent cause of impotence, since the downward curve of the organ is so greatly exaggerated during erection that intromission is impossible. Wounds and lacerations of the floor of the urethra, sometimes internal urethrotomy, will produce the same incurvation.

Fibrous or cartilaginous indurations of either the sheath of the penis or the erectile tissue materially interfere with coitus, not only because of the distortion which always becomes manifest on erection, but because the erectile tissue anterior to this point of induration remains entirely flaccid. These indurations are irregular in their distribution, and are common in the rheumatic and the gouty.

Deeper fibrous indurations, also interfering with function, not unfrequently develop after gonorrhœa, and in some cases syphilis seems to be a factor in the growth of these lesions. When they appear in the form of gummata their specific origin is sufficiently obvious. Calcification sometimes takes place.

The treatment of this condition is unsatisfactory. Gummata can be made to resolve under specific treatment. The hard nodulations and indurated plaques which are observed in gonorrhœa or in gout, or which come without obvious cause, are extremely obstinate. Massage and inunctions of mercury should be employed, together with pressure, which is best applied by means of a thin rubber bandage. The prognosis as to cure must always be extremely guarded.

Aneurismal dilatations of the corpora cavernosa, whether congenital or traumatic, may mechanically prevent coitus. Relief is here obtained by the application of firm rubber bandages or supports.

Varix of the dorsal vein of the penis, though it may attain large dimensions, rarely produces functional disturbance. If it does, excision is the proper remedy. A similar condition of the lymph-vessels may be cured by excision, or by the less radical means of passing a seton through the vessel. A tight frænum should be remedied by incision.

Tumors or swellings about the genitalia may mechanically interfere with function. Thus, elephantiasis of the scrotum, enormous œdema of the prepuce, huge scrotal hernias and immensely protuberant bellies, large scrotal tumors, muscular contractures, hydroceles, all may render coitus well-nigh impossible.

Malformations and diseases of the testicles may also produce impotence. Such deformity is not necessarily attended with any malformation of the penis, though this is the rule.

In anorchidism—that is, congenital absence of the testicles—impotence is complete. Cryptorchids (those whose testicles have not descended) are usually sterile, but not impotent. Removal of both testicles is ultimately followed by impotence, but this may not come on for some years.

Disorganization of the testicular structure either from inflammation or from tumor-growths is also followed by the loss of sexual power. If the inflammation is confined to the epididymis, however, as in the case of epididymitis, the glandular structure of the testes remaining intact, sterility follows, but there is no loss of sexual strength. Syphilis, tubercle, sarcoma, carcinoma, even though they involve but one testicle, are sometimes associated with impotence. The chronic congestion and slow atrophy incident to pronounced varicocele are not infrequently followed by impotence long before gross changes in the testicle have been noted.

Psychical Impotence.—In this form of weakness the sexual organs are normally formed, and erection is possible, but is not properly under the control of the will. At times such patients have vigorous erections. These occur in the morning and on comparatively slight provocation. Under certain circumstances, and usually at times when this failure is most mortifying, erections fail utterly, or, at most, are so feeble as to be of no service. This form of impotence not infrequently attacks the newly married, who fancy that they suffer from some form of sexual weakness incident to early self-abuse. It is sometimes due to a mental impression produced by failure incident to fright, disgust, or other emotions at the first attempt.

Treatment.—The treatment of these cases of psychical impotence should be one calculated to make a strong impression upon the patient's mind. He must be examined with the utmost thoroughness both locally and generally. All causes of local irritation must be removed and every effort made to improve his general health; he should be assured that his weakness is merely temporary and that cure will certainly result. Such patients have generally read pernicious literature, and have usually consulted charlatans: hence they need to be disabused of the teaching that masturbation indulged in moderately and for a short time invariably produces disastrous results.

In addition to the general hygienic directions, including regulation of the diet, attention to the bowels, and exercise, some medicine should be given to these patients, and this should be one appropriate to their general condition, or, if the health is perfect, one which has a tendency to act as an excitant on the spinal centres. Perhaps the best prescription is the following:

℞ Strychninæ sulph., gr. $\frac{1}{20}$;
Phosphori, gr. $\frac{1}{100}$;
Damianæ ext., gr. iii;
M. et ft. pil. no. i.
S.—One pill three times a day.

Under some circumstances moderate stimulation by means of Burgundy or champagne may be beneficial, since the patient is often entirely cured after one successful effort. Absolutely forbidding intercourse acts at times as an excellent stimulus. Patients suffering from this form of impotence should be especially cautioned against trials of their powers with prostitutes, since the circumstances of these trials are little conducive to a normal degree of sexual excitement.

The term RELATIVE IMPOTENCE implies lack of ability to perform the sexual act with certain partners, while with others full strength may be preserved. No rule can be laid down for the management of such cases. Each must be conducted in accordance with its merits, the physician always throwing his influence on the side of morality. Much can sometimes be done by strong mental impression, usually accentuated by the administration of drugs. In many cases impotence upon the part of the man is due to the frigidity of the woman, who does not realize the profound effect of her attitude. Perhaps the best plan in these cases is to advise the man to shun the society of other women, to live well, work little, exercise much.

Atonic Impotence.—Under this heading are included those cases of partial or complete impotence which are due to a weakened condition of the lumbar centres. When these centres are in their normal condition, erection should be vigorous, and coitus should be continued for from three to five minutes before ejaculation, and after ejaculation there should not be immediate subsidence of erection. In many healthy young men the erection can be maintained until two emissions have taken place.

In atonic impotence (1) erections may be vigorous, but ejaculations may be premature, occurring on contact or even before, followed by immediate subsidence of erection; (2) erections may be weak or may be entirely wanting.

The atonic condition of the lumbar centres may be dependent on certain general conditions, such as anæmia, diabetes, uræmia, cholæmia, and rheumatism. Sometimes temporary impotence is one of the first signs of post-diphtheritic paralysis. Wasting diseases, such as consumption, are usually accompanied by this form of atonic impotence. Many drugs if taken until their toxic effects are produced occasion failure of sexual power. Thus, organic lead-poisoning, carbonic acid gas, carbon bisulphide, antimony, and particularly alcohol, tobacco, and opium, may cause complete loss of both power and desire. Impotence resulting from the excessive use of tobacco and alcohol often long outlasts the other bad effects after the habit has been stopped. Certain persons exhibit an idiosyncrasy towards tobacco, which, when taken in such moderation as to produce no constitutional effect, may destroy both sexual desire and power. It is alleged that the cigarette is particularly potent in producing this result.

According to Trousseau, coffee has marked anaphrodisiac effects, and may produce complete impotence. This observation is certainly not in accord with the experience of the majority of surgeons, at least so far as the moderate use of the drug is concerned. If taken in enormous quantities it may of course produce this result, but rather because of the general nervous break-down than because of any special action on the sexual centres. Certain drugs given in physiological doses will produce a marked lessening of sexual power. The bromides are particularly depressing; cocaine is also alleged to have this effect, and morphine in certain individuals is markedly sedative to the sexual centres.

In accordance with the degree of impotence the condition is said to be either irritative or paralytic.

In the irritative form the erections are either perfect or imperfect.

The emissions are always premature, quickly followed by subsidence of erection. The sexual desire is strong.

In the paralytic form erections are absent or feeble, desire is wanting; during orgasm the semen drops from the flaccid penis, with little or no pleasurable sensation.

Of these two forms the irritative is the more common. The cause is in the great majority of cases a diseased condition of the prostatic urethra, the mucous membrane being exceedingly hyperæmic, or chronically inflamed, keeping the centres for erection and ejaculation in a constant state of reflex excitability. This condition of the prostatic urethra may depend upon—(1) gonorrhœal inflammation and its sequel, stricture; (2) excessive venery; (3) prolonged ungratified sexual excitement; (4) strongly acid or irritating conditions of the urine. Of all these causes, gonorrhœal inflammation and its sequel stricture are the most frequent. In most cases of acute gonorrhœa the prostatic urethra is involved to a very slight degree, and the disease, at least in this part of the tube, undergoes complete resolution. In a certain percentage of cases, however, the disease becomes firmly lodged in the prostatic follicles, utricle, ejaculatory ducts, seminal vesicles, or ampullæ of the vasa, manifesting itself only by an occasional apparently causeless outbreak in the form of an acute attack. As a consequence of the continued irritation, the mucous membrane of the prostatic urethra undergoes catarrhal alterations, and the sensory nerve filaments so rich in this part of the tube are involved and reflexly excite the centres for erection and ejaculation. This inflammatory and hyperæsthetic condition of the posterior urethra is still further aggravated by the formation of a stricture.

Atonic impotence from sexual excess is most frequently observed among masturbators, if this habit can properly be classed as "sexual." In the recently married sexual excess is by no means uncommon, but shortly regulates itself. Occasionally it is continued for a long time, and then doubtless works permanent harm: first, by producing a hyperæsthetic condition of the posterior urethra, and consequently one of the forms of impotence; next, by ultimately producing certain fibroid changes in the cord.

Masturbation as a cause of impotence is generally given prominence which is not deserved. This is a habit which practically all boys have had at one time. The popular belief as to the injury which even a slight indulgence in it may cause leads those who subsequently have sexual trouble to refer this back to self-abuse. Even when the habit is continued for years during the period of youth and early manhood it is often followed by no appreciable ill effects: at least such is the testimony of large numbers of medical students. It is however, undoubtedly true that in certain instances, aside from the rooted conviction of the patient, irritative and paralytic forms of impotence can be referred directly to excessive masturbation. The physique and morale of a masturbator are popularly considered as almost pathognomonic. Thus, such patients are supposed to have muddy, pimpled complexions; a cold, moist surface; hollow, sunken, blinking, shifting, watery eyes; lustreless hair; a timid, constrained manner; stooping shoulders; a tendency to swallow frequently, particularly on being embarrassed; weak knees; a shambling gait; shrunken sexual organs, and a solitary disposition, with incapacity for any intellectual effort.

This description no doubt applies to certain aggravated cases. It may, however, be observed in neurotics who are not addicted to the habit, and an extreme degree of masturbation may coexist with the appearance and manners of perfect health.

Atonic impotence from prolonged and ungratified sexual desire is usually observed in men of neurotic temperament, particularly those coming from the rural districts, who, from the circumstances of their life, are exposed to sexual excitement, and who, either from moral reasons or for lack of opportunity, do not indulge in sexual intercourse. Many of these cases can properly be classed as masturbators, since the sexual centres finally become so irritable that orgasm occurs on the slightest provocation, and an opportunity for such provocation is so constantly afforded that exhaustion follows.

The irritability often becomes so marked that the slightest mechanical frictions or jarrings, such as come from riding on horseback or in a jolting wagon, occasion emissions.

In these cases the condition of sexual neurasthenia is unusually well marked.

Since the ordinary lesion of atonic impotence, whatever its remote cause may be, is a hyperæsthetic condition of the prostatic urethra, it is not unreasonable to suppose that the irritation incident to abnormal conditions of the urine may excite a prostatic hyperæmia, resulting in the derangement of the sexual centres. That this is the cause of impotence associated with certain abnormal conditions of the urine cannot be positively asserted, since it is possible that the general condition which occasions the abnormal urine may also operate on the centre presiding over erection. Thus, in complete impotence a careful examination of the prostatic urethra may fail to show the slightest sign of abnormal prostatic condition. In cases of oxaluria, however, the return of sexual strength is often coincident with the disappearance of calcium oxalate in the urine. The irritating effect of acid urine on the prostatic urethra is shown by the persistent priapism which sometimes accompanies acute attacks of gout, in which there is found a heavy deposit of uric acid.

GENITO-URINARY NEUROSES.—Atonic impotence is characterized by certain local and general symptoms, which Ultzmann has admirably described under the general heading of genito-urinary neuroses. He states that the symptoms incident to a hyperæmic or chronically inflamed condition of the prostatic urethra are almost identical with those observed in the female as the result of endometritis. Both the uterus and the prostate are richly supplied with nerves. In men the bladder and seminal vesicles and prostate receive filaments from the vesical plexus, which, in turn, is made up of anastomosing branches from the hypogastric branch of the sympathetic, together with branches from the sacral ganglia and from the pudendal plexus of the sacral nerves. This nerve-supply sufficiently explains why irritation of the prostatic urethra should excite such reflexes as pain passing down the inner surface of the thighs or referred to the hip, the anus, the hypogastric region, or the small of the back.

The general symptoms are those of neurasthenia. Loss of mental power, vertigo, headaches, shortness of breath, indigestion, palpitation, colic, cough, emaciation, wandering neuralgic pains, nervousness, and excitability,—these and many other symptoms of which neurasthenic females complain are duplicated in the male suffering from atonic impotence.

The urine in these cases is often abundant and of low specific gravity. Sometimes there is a transient glycosuria. In some cases the urine is alkaline when it is passed, owing to the presence of carbonates. On heating, the earthy phosphates are precipitated. Indican is observed particularly in those given to sexual excess. Transient albuminuria is sometimes noted. Calcium oxalate frequently appears in great excess. The amorphous crystalline salts of lime and magnesia are also to be found, together with a few spermatozoa.

The neuroses of the sexual centre may be either sensory or motor.

The sensory neuroses present an almost infinite variety. The usual symptoms complained of are a sensation as though fluid was trickling through the urethra; a tickling and burning feeling at the meatus; neuralgic, aching, or burning pains referred to the testicles, anus, inner surface of the thighs, hypogastric region, small of the back, or any of the regions innervated by branches communicating with the hypogastric and sacral plexuses; pain in the testicles and burning in the meatus after ejaculation; and extreme sensitiveness to the passage of instruments. In aggravated cases the urethra becomes anæsthetic, and the penis feels cold, is shrivelled, and is sometimes so non-sensitive that even applications of an electric brush occasion no pain.

The motor neuroses of the urinary and genital systems may take the form of over-action or of paralysis. Vesical irritability is sometimes manifested by paroxysmal dribbling or even complete stoppage of the urine, occasioned either by a lack of contraction of the smooth muscular fibres or by spasm of the compressor urethræ. So-called stuttering urine may be due to the same cause. When the detrusors of the bladder are involved in over-action there is difficulty in retaining water. Urination is frequent and urgent, and is usually not associated with pain, but sometimes there is marked tenesmus. Paralysis of the sphincters or detrusors is extremely rare; in the one case it would occasion dribbling of the urine and in the other retention. The motor neuroses of the sexual system may be manifest in the form of priapism, or of partial or complete impotence, often associated with involuntary seminal emissions and spermatorrhœa. Priapism is observed only in the early stages of acute involvement of the prostatic urethra; impotence is common in chronically inflamed conditions. The frequent pollutions complicating it are due to spasm of the detrusors of the seminal vesicles and the vasa deferentia. Spermatorrhœa or dribbling of the semen without the sensation of an orgasm is due to paresis of the muscular fibres of the ejaculatory ducts.

The secretory neuroses of the genital system are manifested in the form of polyspermia, or ejaculation of abnormal quantity of semen; aspermia, or absence of semen; or prostatorrhœa, a discharge made up of the secretions of the prostatic glands, the glands of Cowper, and the urethral crypts and follicles.

The Diagnosis of Atonic Impotence.—A careful history will often indicate whether impotence is due to psychological influence, to organic changes, or to exhaustion of the lumbar centres. Examination should be made not only of the sexual organs but also of the heart, of the lungs, and of the system at large. Examination of the urine should never be omitted; the total quantity in the twenty-four hours, the specific gravity, the reaction, the deposit, the presence or absence of abnormal constituents, must all be carefully noted. Microscopic search will determine whether or not pus is to be found. The source of this pus must be discovered in the method described when considering the treatment of posterior urethritis. The anus should be explored carefully, since lesions in this region may excite reflexes which are referred to the genital tract.

Finally, the sexual organs must be carefully examined; the testicles are palpated, and their size, position, consistence, sensitiveness, and the presence or absence of swellings and new growths are noted. The penis is similarly examined, its circumference behind the glans recorded, and the urethra carefully palpated for indurations along its track. The prepuce is subjected to careful scrutiny, the meatus is inspected, and finally the urethra is explored exactly as in searching for strictures. In many of these cases spasmodic contraction of the compressor urethræ muscle is particularly marked. A full-sized sound passed to the membranous urethra and kept gently pressed against its anterior opening will finally slip through, not with a jump, but rather as though an attempt were being made to pass it through a tight, flexible tube without previously lubricating it. Sometimes it seems to be drawn in with a swallowing motion. During the introduction of the instrument not only should the points of resistance to its entrance be noted, but also areas of unusual tenderness. The posterior urethra is extremely sensitive; in cases of the paralytic type, however, the passage of a sound is absolutely painless.

If the meatus is so narrowed that it will not admit a full-sized sound it should be cut. Urethroscopic examination is rarely necessary in these cases, at least until the failure of ordinary treatment suggests the possibility of some unusual pathological condition, such as polypoid growth.

An examination thus conducted will show a hyperæmic or inflammatory condition of the posterior urethra, either associated with stricture or other obstructive lesion, or simply remaining as the result of repeated prolonged congestion or previous acute inflammation.

The prognosis of atonic impotence is good, except in the most advanced cases. When strictures or granular patches in the anterior urethra are the exciting causes, the cure of these is followed by the disappearance of the symptoms of impotence.

When the symptoms are due to the persistence of a posterior urethritis, local applications are curative. When impotence is caused by impaired health, the outlook is favorable, provided the general condition can be improved. Even though erections are entirely absent at times when they are most desired, or are of such short duration as to be of no practical service, if the patient has voluptuous dreams with erection, and particularly if he has an occasional morning erection, the chances of ultimate cure are good. The prognosis is bad only in such cases as have no erection at any time, the semen dribbling without pleasurable sensations, and the penis being cold, shrivelled, and non-sensitive.

Treatment.—The treatment of atonic impotence must be both general and local. The daily life of the patient should be carefully regulated. The hours of sleep, the diet, the amount and kind of exercise, should all be prescribed. The bowels should be kept regular, and general treatment should be instituted when this is required to combat the pathological conditions of the urine. During treatment the patient must be particularly cautioned against venereal excitement of any kind, whether from reading, conversation, or associations, and against testing the efficacy of his treatment by an occasional trial of strength.

All sources of reflex irritation must be removed. Fissures or hemorrhoids in the rectum, phimosis, or narrow meatus should receive prompt surgical treatment. Some cases of impotence have been cured by the removal of a hemorrhoidal mass, by the slitting of the meatus, or by treatment directed to the destruction of lumbricoids or ascarides. Even a moderate degree of varicocele should be remedied either by a suspensory bandage or by operation.

If in the course of treatment the thoughts are in spite of every effort turned to sexual topics, the patient should be instructed to counteract this tendency in its very beginning by vigorous and prolonged exercise and cold baths.

The local treatment has for its end the restoration of the entire urethra to a normal condition. Strictures must be cured by section or dilatation, granular patches healed by applications through the endoscope, and hyperæsthetic and inflammatory conditions of the posterior urethra treated by irrigation, instillations, and the passage of full-sized cold steel sounds, or by the use of the psychrophore.

The sound should be introduced every third or fourth day and should be of full normal calibre. When the urethra is extremely hyperæsthetic, injections of cocaine, first into the anterior urethra, then into the posterior part of the canal by means of an instillator, will render instrumentation comparatively painless.

When there are distinct evidences of congestion or inflammation in the posterior urethra, in addition to the sound, irrigation and instillation will usually be necessary before cure can be accomplished. (See Treatment of Chronic Posterior Urethritis.)

When inflammation is absent, or after it has been cured, if hyperæsthesia still persists, this is best combated by the prolonged application of cold. The passage of a cold sound accomplishes this end in an imperfect way, since the metal is soon heated. The psychrophore (Fig. 253) will, however, permit of a continuous cold application for as long a period as is desired. This instrument is made in the form of a hollow sound, through the curved extremity of which a stream of water of the desired temperature constantly flows. It is so devised that the sheath of the instrument which passes through the anterior urethra is not kept cold by the liquid, which flows through pipes contained in the sheath, but separated from its walls by air-spaces. It is only in the terminal three inches that the water is allowed to come immediately in contact with the walls of the instrument.

FIG. 253.

Psychrophore.

The psychrophore should be as large as the normal calibre of the urethra. It is introduced until its curved portion occupies the membranous and prostatic urethræ; then a current of water of the desired temperature is allowed to pass slowly through it, thus maintaining the chamber at its end at about the temperature of the water. In cases of hyperæsthesia attended by the irritative form of atonic impotence, cold water is most serviceable. The temperature of this should be between 40° and 50° F., and the treatment should be kept up for from five to ten minutes every second or third day. In the paralytic form of atonic impotence hot water from 106° to 110° F. should be chosen.

Heat or cold may be applied through the rectum in the form of injections, or a rubber bag introduced within the grasp of the sphincter.

Rectal injections are so planned that the solution of choice (sodium chloride solution, seven-tenths per cent.) is thrown upward in a forcible stream against the prostate, and is allowed to escape immediately without distending the bowel. This end is readily accomplished by the instrument pictured in Fig. 226. The selection of heat or cold will depend upon the type of disease and the sensations of the patient. At least a quart of solution should be used daily. Dry heat or cold through the rectum is readily applied by means of a modified Barnes's bag inserted into the rectum and distended with either hot or cold water. This method of treatment is to be commended, since it adds to the beneficial effects of temperature those incident to pressure.

When by the means already described urethral hyperæsthesia has been entirely subdued and yet impotence still persists, other methods of treatment must be employed to restore power to the weakened centres and also to the muscles concerned in erection and ejaculation. Full doses of strychnine are advisable in these cases, and particularly strychnine in combination with phosphorus and damiana. Massage and general electricity are useful.

The needle spray applied once a day to the external genitalia at the time of the morning bath is tonic and stimulating. The water should be driven forcibly against the inner surfaces of the thighs, the hypogastric region, the buttocks, and the small of the back, and should be alternately as hot as can be borne and as cold as possible. The applications should be continued for from two to five minutes.

Electricity is one of the most valuable means of stimulating the sexual centres. Both the galvanic and the faradic current seem to be of value. It is employed not only as a general nerve tonic, but also as a means of directly exercising the perineal muscles concerned in erection. The current should be first applied to the spine, and then used locally. The positive pole is placed over the lumbar region ; the other is carried to the perineum, the anus, the hypogastric region, or the prostatic urethra, and swept over the external genitalia, the buttocks, and the inner surface of the thighs.

The rectal electrode is serviceable in cases of imperfect erection and loss of power of ejaculation; it is particularly valuable because by means of a slowly interrupted current it exercises the entire perineal group of muscles. The important part these muscles play in erection has been shown already, and restoration of their vigor by the use of electricity is often followed by complete recovery of sexual strength. The application should last from fifteen to twenty minutes and be repeated daily for several weeks or months.

The urethral electrode allows the current to be applied directly to the prostatic urethra. Both galvanic and faradic currents are employed, the gauge as to strength usually being the sensation of the patient. An electrode properly placed and conveying a slowly interrupted current strongly exercises the sphincter of the bladder, the compressor urethræ, and the unstriped fibres of the prostate, probably including those of the ejaculatory ducts: hence in cases of spermatorrhœa this treatment is particularly serviceable. When the galvanic current is employed it should never be of such strength as to occasion electrolytic action.

In some cases which do not yield to other treatment, a complete course of hydrotherapy, including, as it does, change of air, surroundings, and occupation, is sometimes advisable, or, in place of this, prolonged out-door but not solitary life.

Two of the symptoms of atonic impotence are so conspicuous as to deserve separate consideration: these are prostatorrhœa,—that is, intermittent discharge of prostatic fluid from the urethra,—and spermatorrhœa, or involuntary loss of semen.

Prostatorrhœa is characterized by a discharge during defecation, after urination, and at times of sexual excitement, of a white-of-egg-like substance from the urinary meatus. This same substance may be caused to flow from the meatus by pressure upon the prostate through the rectum. Microscopic examination of the discharge shows that it is made up of leucocytes, cylindrical epithelium, and concentric amyloid concretions; Böttcher's sperm crystals and casts of the prostatic ducts, closely resembling renal casts, are also found. Blood is rarely present.

Prostatorrhœa is dependent on a chronic catarrhal condition of the prostatic urethra, involving the ducts and follicles. Gonorrhœa and prolonged ungratified or unnaturally gratified sexual excitement most often produce this catarrhal condition. On examination of the prostate per rectum it will not usually be found materially increased in size, although occasionally the nodular outline indicative of follicular prostatitis can be felt. The most prominent symptoms of this condition are—(1) A marked condition of sexual neurosis, perhaps a reflex from the catarrhal region, usually aggravated because the patient believes that the discharge is semen and that thus his strength is draining from him. (2) A discharge at stool and after urination of viscid prostatic mucus. The hypersecretion is going on steadily, but, owing to the tonic contraction of the compressor urethræ muscle, cannot pass forward until the resistance of the muscle is overcome by the pressure of hardened masses of fæces, or by the reflex required by the act of micturition. In some aggravated cases the compressor urethræ muscle becomes so weak that the discharge will flow forward almost constantly. If many spermatozoa are found in the discharge, the case must be regarded as one of spermatorrhœa. (3) Frequency and some urgency in urination, tickling or aching sensations in the prostatic urethra, and reflex pains in the back, rectum, hypogastrium, and down the inner surface of the thighs. (4) Partial or complete impotence. Exceptionally, beyond the prostatic discharge, there are no symptoms.

The prognosis of prostatorrhœa is usually good. Even when habitual masturbation causes prostatorrhœa, the prognosis is fairly good, provided the paralytic form of impotence has not been reached and the patient has some strength of will on which to build.

Treatment.—The treatment is especially that directed to the cure of congestion or inflammations of the posterior urethra. When a depressed condition of the system or irritating urine seems to be the cause of prostatorrhœa, corrections of these departures from health may be followed by prompt cure.

It is particularly important that the bowels should be kept open. Magnesium sulphate or Hunyádi water in the morning will accomplish this; fluid extract of cascara, twenty drops three times a day, is useful. Both exercise and diet must be carefully regulated. Horseback or bicycle riding should be forbidden in cases of follicular prostatitis, or in those whose symptoms after a trial are made distinctly worse. Often these exercises provide a species of massage for the prostate which acts most beneficially upon it. The prostatic mucous membrane seems to be particularly sensitive to the effect of chilling: hence patients suffering from prostatorrhœa must be carefully protected against wet feet, draughts, and other causes of cold.

When there is pus in the discharge or in the shreds found in the urine, the treatment is that appropriate to posterior urethritis.

The medical treatment is of minor importance, but should none the less receive attention. When the inflammation is one of long standing, stimulants may be required. Here oil of sandal wood in ten-minim doses three times a day, taken one hour after meals, will be of great help. Cubebs, copaiba, turpentine, and cantharides, the latter in small doses, are all useful. When the bladder is irritable, belladonna, fifteen drops of the tincture three times a day, is beneficial. When the urethra is especially hyperæsthetic, and particularly in cases of marked sexual neurasthenia, potassium bromide, administered in twenty-grain doses three times a day, may quiet the nervous symptoms. As a rule, tonics, compound syrup of hypophosphites in teaspoonful doses, emulsion of cod-liver oil with iodide of iron, and iron and nux vomica, should be recommended. We have found hyoscine and hyoscyamine sulphate particularly efficacious in the non-inflammatory forms of prostatorrhœa.

It is upon local treatment, however, that most reliance must be placed. This consists in the use of steel sounds, the psychrophore, the prostatic dilator, the rectal bag, the rectal douche, irrigations, and instillations.

Instillations in these cases should be more astringent than in an ordinary inflammatory case: thus, fluid extract of hydrastis or pure zinc sulphate, twenty grains to the ounce, may be employed. Soluble prostatic bougies are prescribed only when it is impossible for the patient to see his physician. Under these circumstances instruction may be given as to the proper method of inserting these bougies. The latter may be ordered in accordance with the indications, using the strongest and most astringent in the oldest cases. Among the most useful bougies is one containing the following:

Zinc sulphate, gr. ii;
Carbolic acid, ♏ii;
Fluid extract of hydrastis, ♏xv.

The prostatic dilator (see Fig. 63) is sometimes of service. It probably accomplishes its good effect by mechanically emptying the inflamed follicles and thus allowing the instillation, which should immediately follow the stretching, to reach to the deeper parts of the diseased mucous membrane; the solutions of choice and the method of instrumentation have been given. (See Chronic Posterior Urethritis.) Stretching by means of the dilator should be carried as high as No. 36 of the French scale and not higher than No. 44. Full dilatation of the prostatic urethra by means of ordinary sounds is impossible, since an instrument of sufficient size to overstretch the membranous urethra fits loosely in the wider prostatic portion of the tube.

Blisters applied to the perineum and the hypogastric region have been warmly commended. If used, the blistered area should be small, the application of the vesicant being frequently repeated.

Electricity is sometimes a useful agent in prostatorrhœa. The galvanic current is most popular, one pole being applied to the lumbar region, the other to the prostatic urethra.

Usually it is best strictly to interdict intercourse; though when prostatorrhœa occurs in married men as the result of long-continued excess it is wise for a time to allow of moderate indulgence, since otherwise the local congestion incident to prolonged excitement without gratification might counteract the effect of treatment. The advisability of allowing moderate intercourse must be determined by the immediate effect; thus, if the discharge is increased, and particularly if the patient feels exhausted and suffers from lumbar pains, intercourse must be forbidden.

Under proper treatment recovery may result in from one to three months, though in some cases a much longer period of time is required. Certain cases are aggravated by local treatment. Under these circumstances it is advisable to make a complete change of life and surroundings. An active open-air life will sometimes be followed by ultimate cure.

Involuntary Seminal Emissions.—These may be due to erotic dreams, or may be occasioned by a local hyperæsthesia so marked that stimuli too feeble to produce any effect in health become sufficient to excite ejaculation. The involuntary emission may occur at night or in the day, and the semen may escape intermittently in the form of pollutions or as an almost constant flow.

NOCTURNAL POLLUTIONS.—In continent men it is entirely compatible with health to have nocturnal pollutions as frequently as once a week. When during the waking hours there has been prolonged sexual excitement, these pollutions may occur much more frequently, two or three times a week, and yet indicate no abnormal local or general condition. It is, however, by no means rare to find continent men in perfect health who have no pollution for weeks or months at a time; it is especially in those who are kept constantly occupied both in mind and in body that this is observed. After prolonged exertion, either mental or physical, it is not uncommon for two or three emissions to occur in a single night. The pollutions may be unattended by voluptuous dreams, and may occur with the penis flaccid. It is possible for the variations just named to be found within the limits of perfect health.

The gauge as to whether the loss can be considered indicative of either local or general weakness is the condition of the patient. If aside from imaginary sufferings these pollutions are followed by weakness, backache, and mental depression, if they are habitually frequent, and particularly if they are associated with sexual weakness or impotence, they must be regarded as an index of disordered function. At first nocturnal pollutions, even though they occur with extreme frequency, are usually associated with full sexual strength; later, as the excitability of the ejaculatory centre becomes weakened, there is usually developed a more or less profound form of sexual weakness.

DIURNAL POLLUTIONS indicate a degree of sexual weakness much more marked than do even excessive seminal losses occurring during sleep. In these cases the slightest psychical or physical stimulus is often sufficient to excite emission. The presence of women, the jarring of a wagon, manipulations necessary for cleaning the foreskin, or even examination of the skin surface around the genitalia, may occasion pollutions. The erections are usually imperfect, the voluptuous sensations are blunted, and immediately after emission there is subsidence of the erection.

SPERMATORRHŒA.—This condition is characterized by oozing out of the semen without erection or pleasurable sensation. It is occasioned by erotic thoughts, or by light mechanical stimuli. or may occur independently of these causes, the semen escaping with the urine or during defecation as in prostatorrhœa.

Spermatorrhœa in the sense of a constant flow of semen from the urethra is extremely rare. It is occasionally observed in vigorous men much given to sexual excess who become suddenly continent. In these cases a whitish discharge is observed, which on examination is found to be swarming with spermatozoa. In such cases spermatorrhœa is unassociated with impotence, and there is often but a moderate degree of sexual hypochondriasis. Slight and intermittent spermatorrhœa is comparatively common in chronic posterior urethritis, even when there is no appreciable functional weakness.

A typical sufferer from spermatorrhœa represents the most aggravated form of impotence. Both desire and power of erection are usually lost, and voluptuous sensations are excited only by the strongest stimuli.

The diagnosis of spermatorrhœa must be founded on microscopic examination. A few spermatozoa in a mucous discharge are probably accidental, and do not necessarily indicate any pathological condition. If great numbers are constantly present in the urine and in the discharge occurring after defecation or urination, it may be assumed that there is a condition of true spermatorrhœa.

The differential diagnosis from prostatorrhœa is not particularly important except from a prognostic stand-point, since the treatment of aggravated forms of the two affections is very much the same.

Treatment.—The treatment of involuntary seminal emissions is that appropriate to atonic impotence, since both these conditions are symptomatic of an irritable condition of the lumbar centres.

The treatment of nocturnal pollutions must be conducted upon rational principles. First, it must be determined whether such pollutions indicate an abnormality. Usually the patients applying for the relief of this condition have seminal losses not more frequently than is consistent with perfect health. When the loss is excessive, or even when it is strictly confined within normal limits, if the patient is markedly hypochondriacal, a vigorous treatment should be instituted. General hygienic directions are given; the patient is particularly cautioned against sexual excitement. By means of a saline or other mild laxative the bowels are opened at night before retiring. The bed should be hard, the covering light; sleeping in the dorsal decubitus should be avoided by tying a towel around the waist with a knot over the spine. An alarm-clock is set to ring about four hours after the time of going to bed, the patient then rising and passing water. Before going to bed, light calisthenics to the point of perspiration, cool sponge bath, and brisk rubbing down are advisable.

When in spite of these precautions erections and emissions occur, an anti-pollution ring may be worn. This is designed to fit comfortably about the penis when the organ is in its flaccid condition; when it becomes erect a number of sharp teeth dig into the skin, and by the pain they excite wake the patient. All sources of reflex irritation must be sought for and removed. Medication directed to subduing the irritability of the lumbar centres is sometimes most serviceable. Potassium bromide, from thirty to ninety grains at bedtime, is temporarily useful. Atropine, one three-hundredth of a grain three times a day, or twice this quantity given at bedtime; hyoscine, one two-hundredth of a grain; hyoscyamine sulphate, one one-hundred-and-fiftieth of a grain; lupuline, one-twentieth of a grain three times a day; and monobromate of camphor, five grains three times a day, are all serviceable: hyoscyamine is almost a specific.

The treatment of diurnal pollutions is conducted on the same general principles as that of atonic impotence, except that, as this symptom usually denotes an advanced catarrhal alteration of the prostatic urethra, strong applications to this portion of the canal are usually necessary. In addition to the various instillations the solid stick of silver nitrate may be used advantageously. The hot rectal douches, the needle spray, electricity, and the treatment appropriate to nocturnal pollutions are applicable in these cases.

In cases of seminal incontinence (spermatorrhœa) the treatment should be directed towards restoring tone to the paretic vessels and revitalizing the exhausted lumbar centres. Of the drugs employed, strychnine, one-twentieth of a grain four times a day; damiana, five grains three times a day; phosphorus, one-hundredth of a grain three times a day; fluid extract of ergot, a teaspoonful three times a day; and arsenous acid, one-fortieth of a grain three times a day, are valuable. Electricity is particularly serviceable. The psychrophore, hot rectal douches, strong posterior applications, particularly the solid stick of silver nitrate, or instillations of pure iodine or of iodine and carbolic acid mixed, will give the best results.

Many cases of sexual weakness are made worse by treatment. If after one thorough trial of methods which careful examination has shown most likely to be successful there is no improvement, local treatment, in the absence of local lesions, should be abandoned, the physician devoting his whole attention to the improvement of the general health of the patient.

Priapism.—Persistent penile erections unaccompanied by sexual desire, at times extremely painful, and interfering with the function of urination are usually expressions of spinal lesion, particularly that due to syphilis, to beginning sclerosis, or to the infiltration of leukæmia. Cerebellar hemorrhage and spinal trauma sufficiently severe to cause paraplegia also produce this symptom. Intermittent priapism, usually annoying rather than painful, is a frequent accompaniment or sequel of prolonged mental strain in neurasthenic men.

The prognosis is grave from the stand-point of the causative lesion.

The treatment of the intermittent neurasthenic forms of this affection should aim at rest and improvement of the general health. If a thorough examination excludes cerebral lesions, then patients can be assured that the symptom which to them is often most alarming has no serious significance, and that local treatment is not indicated. Small doses of hyoscyamin sulphate, gr. $\frac{1}{200}$, twice daily, are often serviceable, but bromides or other depressants are, as a rule, distinctly hurtful. Exceptionally a local lesion such as chronic posterior urethritis may cause intermittent priapism, and in such case direct treatment is indicated. Exceptionally, even in the absence of local lesions, the passage of a sound is helpful. The observance of general hygienic regulations and treatment directed to the relief of gout, rheumatism, or other systemic condition which may require medication are followed by cure.

Priapism dependent upon syphilis of the cord calls for massive doses of mercury and the iodides. When, because of leukæmic infiltrate or pressure on the cord from chronic inflammatory exudate or tumor, the erection becomes persistent and hurtful, ice-bags in the rectum may be helpful. Section of the pudic nerves may be needful to give relief in rare cases.

Impotence in the Female.—Impotence in the female, in the sense of inability to accomplish the sexual act under normal and lawful conditions, may be classified under the following headings: (1) intromission of the male organ is impossible; (2) intromission is possible, but either excites pain or fails to cause orgasm.

Intromission of the male organ may be prevented by congenital or acquired obstruction, or by obliteration of the vulva and vagina. The congenital anomalies may appear in the form of absence of the vagina, extreme narrowing, division into two parts, each too small to allow of intromission, or opening in abnormal positions, as, for instance, into the rectum. The vulva may be obstructed by adhesions, by hypertrophy of the labia or clitoris, or by a rigid or imperforate hymen. Acquired obstruction may depend upon cicatricial contraction, inflammatory swelling, new growths, or hypertrophy of the parts.

The treatment of impotence dependent upon congenital absence of the vulva or vagina is of little avail. In cases of narrowing, continuous dilatation may bring about cure. A rigid or imperforate hymen, adherent labia, or mechanical obstructions, as from swellings or tumors, can be remedied only by surgical operation.

Intromission may be mechanically possible, but may be resisted or entirely prevented because of the pain occasioned by the attempt. Thus, acute inflammations about the vulva, vagina, uterus, or ovaries will render sexual approach extremely painful; urethral caruncles, urethritis, fissures of the neck of the bladder, hemorrhoids or rectal fissures, ulcers and displacement of the womb, inflammation of the Fallopian tubes, and disease or prolapse of the ovaries, are frequently observed as causes of this condition.

Usually, on account of the pain, the perineal muscles become spasmodically contracted and intromission is impossible. Sometimes this spasm does not occur until entrance is accomplished, in which case the male organ may be so tightly imprisoned that release is accomplished only when the muscles of the female are relaxed by ether. It is customary to class vaginismus among the pure neuroses. A careful search will, however, in almost every case reveal an inflammatory area from which the reflex starts. In most of these cases the origin of the reflexes is to be found in fissures in the neck of the bladder; urethral caruncle and urethritis are also frequent causes of vaginismus. As a very rare exception the only pathological condition to be detected is an apparently causeless hyperæsthesia of the vaginal mucous membrane.

The treatment of vaginismus depends for successful issue upon the skill and thoroughness with which local examination is made. An exhaustive search should be made for the source of the reflexes. In the absence of any cause discoverable by palpation or inspection of the genitalia, a thorough endoscopic examination of the bladder must be made.

The cure of vaginismus depends upon the cure of its exciting causes. Where, as is usually the case, there are found several abnormal conditions, each of which may possibly be responsible, such as extensive fissure in ano, chronic endometritis, and granular urethritis near the neck of the bladder, all these abnormal conditions should be remedied.

In the absence of any local pathological condition, vaginal douches of hot one per cent. soda solution, followed by the application of ten per cent. cocaine solution to the vulva and the lower portion of the vagina, may render introitus comparatively painless. These patients, belonging as they do to a neurotic type, should receive treatment appropriate to their general condition.

STERILITY.

Sterility in the male is that condition in which there is loss of procreative power. This necessarily implies absence of living spermatozoa, since these are the elements essential to impregnation, but it does not imply failure of power in sexual congress.

Failure to bear children on the part of married women is due in a certain proportion of cases to sterility of the husband. The definite percentage cannot be given, since the whole subject is somewhat obscure. Thus, it is well known that a marriage may remain barren, but that each partner of this marriage, after other sexual relations, may become a parent. The percentage of sterile husbands in childless marriages has been variously calculated at from five to twenty.

The composition and physical qualities of normal semen have been already described. The total quantity and the number of spermatozoa are markedly diminished by sexual excess and wasting diseases. Sterility may be manifest by—

(1) Aspermia, entire absence of semen.

(2) Oligospermia, diminution in the quantity of semen.

(3) Azoöspermia, absence of spermatozoa.

Aspermia is a condition in which no seminal fluid is ejaculated, though the act of coitus may be performed normally in other respects. Aspermia may be due to imperfect coördination of the muscles of ejaculation; sometimes it is an expression of sexual weakness. In this case, though there is no escape of semen during orgasm, it may subsequently drop from the end of the flaccid penis.

More rarely there may be seminal emissions only during sleep, prolonged and repeated efforts utterly failing to produce emission during or after coitus. In this case incoördination probably involves the muscles which force the seminal fluid into the prostatic urethra and the dilatation of the bulb, or failure in emission may be due to sensory paralysis.

As a modification of this form of aspermia, patients are seen in whom ejaculation sometimes takes place during coitus and sometimes cannot be excited.

The common cause of aspermia is obliteration or obstruction of some portion of the urethra. This obstruction may be congenital or acquired. The acquired form may be due to traumatism or inflammation. When inflammation has attacked and destroyed the greater portion of the secreting substance of the prostate, and has blocked the ejaculatory ducts, after orgasm there will be a discharge of two or three viscid drops, representing the secretion of Cowper's glands and the urethral crypts and follicles. Tubercular infiltration, malignant degeneration, the pressure of tumors, tight stricture, or the blocking of the passage by a prostatic or cystic calculus may produce aspermia. Injury to the common ejaculatory ducts, without involvement of the prostate, will cause diminution in the quantity of semen secreted and absence of spermatozoa, but not aspermia, since the prostatic secretion is ejaculated and presents at least the gross physical attributes of normal semen.

The term false aspermia, or malemission, is sometimes employed to designate that condition in which semen is discharged into the urethra but does not reach the meatus, either passing back into the bladder to be voided with the urine or exuding drop by drop from the urethra after coitus has been completed. This is commonly due to stricture, which may be of such calibre as not to interfere with the function of micturition when the circulation of the parts is in its ordinary condition, but which so encroaches upon the urethral calibre as the result of congestion incident to erection that the passage is practically obliterated. Another form of malemission is the condition in which the semen is not properly ejaculated into the vagina because of some defect in the urethra, such as hypospadia, epispadia, or urethral fistulæ. Such a patient is neither sterile nor impotent, yet he is incapable of impregnation.

Oligospermia, or a diminution in the quantity of semen ejaculated, may be due to deficiency in quantity or absence of any of the constituent parts of this fluid. Oligospermia may be due to general weakness, debilitating disease, sexual neurasthenia, sexual excesses, masturbation, or any of the various inflammatory or infiltrating affections which obliterate the ducts of the glands the secretion of which goes to make up the semen.

OLIGOZOÖSPERMIA indicates a condition in which the semen ejaculated contains few spermatozoa.

AZOÖSPERMIA, or absence of spermatozoa in the semen, may be due to absence of both testes, to failure of the testes to produce spermatozoa, or to mechanical obstruction in some portion of the passage by which spermatozoa reach the urethra. The testicles fail to secrete spermatozoa when there is bilateral retention, atrophy, or malignant, syphilitic, or tubercular degeneration. Even unilateral affections of the testicles frequently cause azoöspermia. Prolonged exposure of the scrotum to the x-ray produces oligonecrozoöspermia or true azoöspermia. The latter condition is common in Röntgen-ray workers.

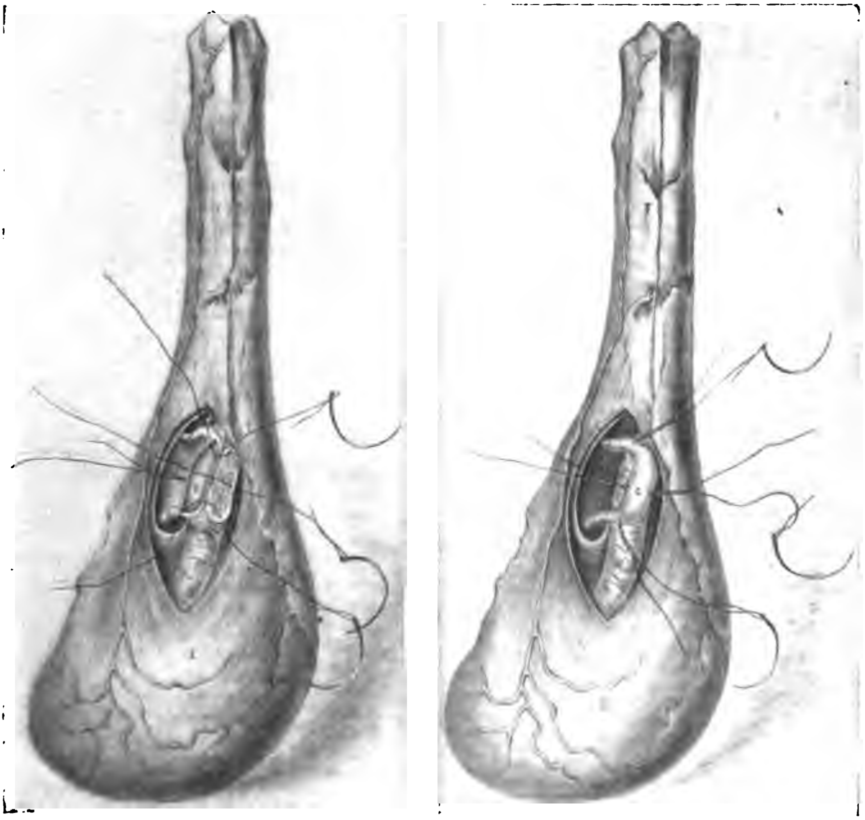
The ordinary cause is bilateral gonorrhœal epididymitis. This is followed by azoöspermia in a fairly large percentage of cases, though not in the majority of those carefully treated. The obstruction following a double obliterating gonorrhœal epididymitis is usually placed in the tail of the epididymitis, but healthy spermatozoa continue to be formed in the testes in spite of the obliteration. Obstruction of the vasa, either congenital, as from absence or occlusion, or acquired, as from traumatism or malignant or tubercular degeneration, or blocking of the common ejaculatory ducts, will prevent spermatozoa from reaching the urethra. Bilateral blocking of the ejaculatory ducts as the result of chronic gonorrhœal posterior urethritis is not uncommon, but it will not produce aspermia, since it simply prevents the secretions of the seminal vesicles and the contents of the ampullæ of the vasa from being discharged into the urethra. Sexual excess produces temporary azoöspermia.

It is to be remembered that the semen discharged by those suffering from azoöspermia may be normal in odor, consistence, and primary gelatinification. On standing the white deposit is thinner; on microscopic examination the absence of spermatozoa is at once detected. This semen deposits the spermatic (Böttcher) crystals very rapidly.

Alterations in the color of the semen have been occasionally observed. It may be red from admixture with blood due to inflammation or intense congestion of the vesicles, vasa, or prostatic urethra. Unless the bleeding has been recent, the color will be a dirty chocolate. A large quantity of pus mixed with the semen may give it a yellowish or greenish tint. Indigo is sometimes found as a coloring matter, and is said to impart a reddish color to the fluid much like that due to admixture with blood.

Treatment.—Sterility dependent upon absence or imperfect development of any portion of the secreting or excreting apparatus is incurable. When due to gonorrhœal epididymitis of comparatively recent origin it usually proves amenable to the treatment described under the head of gonorrhœal epididymitis. When the obstruction persists, we have succeeded in relieving it by performing an anastomosis between the vas and that portion of the epididymis to the testicular side of the obstruction. The vas lies behind the spermatic artery, which sends its main branches forward to the inner side of the epididymis, anastomosing freely at this point with the artery of the vas. The epididymis is approached from its outer side. A portion of the head is picked up in toothed forceps and excised. If this excision is made on the testicular side of the obstruction there will ooze from the wound, semen which contains motile spermatozoa. The lumen of the vas is opened by a longitudinal cut one-quarter of an inch long. Into this wound of the epididymis the vas is implanted by means of four fine silver-wire sutures, carried on small face needles from the outer surface of the vas into its lumen; thence from the cut surface of the opening made into the epididymis through its fibrous tunic. (Fig. 254.) Because of the smallness of the structures involved, the operation is tedious rather than difficult. Aside from the ordinary surgical instruments, there will be needed a sharp-pointed pair of scissors, a slender bistoury, and a grooved director, such as are used by ophthalmologists.

FIG. 254.



Anastomosis between the vas deferens and the head of the epididymis.

When the sterility is dependent upon blocking of the common ejaculatory duct, no treatment has been suggested which promises favorable results. Sterility dependent upon stricture is cured by full dilatation of the urethra. If due to muscular incoördination, tonic or stimulant treatment directed to the general nervous condition may be beneficial. That form of sterility which is apparently dependent upon chronic suppuration of the prostatic urethra, ejaculatory ducts, seminal vesicles, and ampullæ of the vasa is best treated by massage, combined with unirritating antiseptic urethral irrigations.

CHAPTER XXII.

PSYCHOPATHIA SEXUALIS.

The various forms of perversion or aberration of the sexual instinct are, as a rule, associated with symptoms which belong to the domain of the neurologist or the alienist. But some of them have a physical basis which demands attention from the genito-urinary specialist, who is, at any rate, apt to be first consulted in many such cases. Moreover, the distinction between a pure neurosis and one dependent upon lesions often requires the judgment of an expert, based upon a thorough examination of the genital tract. It seems proper, therefore, to present a brief summary of the chief varieties, and to give at least a *résumé* of the general principles which should apply in dealing with these patients. The works of Krafft-Ebing and Schrenck-Notzing are the most valuable of recent contributions to this subject, and have been used freely in the preparation of this chapter.

An accurate and entirely scientific classification of these phenomena is at present impossible, but a provisional one may be employed, which will aid in the systematic study of the subject.

Nearly all the known varieties of sexual perversion will fall under one or other of the following headings:

A. SEXUAL HYPERÆSTHESIA.
  1. Onanism.
  2. { Satyriasis.
       Nymphomania.
B. SEXUAL ANÆSTHESIA.
  Impotence. (See Chapter XXI.)
C. SEXUAL PARÆSTHESIA.
  1. Heterosexual perversion,—algolagnia. Perverse activity of the sexual impulse.
  2. Inversion of the sexual feeling (contrary sexual feeling; homosexuality, etc.).

Sexual hyperæsthesia, when not dependent on affections of the cord or on cervical disease, is usually associated with hyperæsthesia of the deep urethra. This in its turn may be caused by masturbation when practised in great excess, by urethral stricture, by sexual intemperance (which term should include both excessive intercourse and prolonged abstinence), by departure from the normal or physiological in the performance of the act of copulation (as, for example, the practice of withdrawal for the prevention of conception), and in various other ways. Certain drugs produce it, cantharides being the best known.

Onanism is the most wide-spread of these causes, a majority of males having at some time in their lives practised it. Much difference of opinion prevails even in the profession as to its exact importance as a cause of cerebral or spinal disease.

Its alleged consequences are used by quacks to foster the miseries of the sexual hypochondriac, who, having almost always been a masturbator to some extent during his youth, is easily led to believe that he has thus done himself serious injury. It is thought, however, by many practitioners that, apart from the question of morality, the effect of the act itself on the nervous system is injurious. Von Schrenck-Notzing, in reply to the argument that the single act of masturbation is no more harmful than that of normal coitus, says that masturbation has a much more intense psychical effect than sexual intercourse, as the content of ideas in every onanistic act must overcome reality, and thus a much more intense strain of the imagination is necessary. He adds, however, that "masturbation moderately practised exercises on a good constitution no direct destroying effect, but it changes, when it is long indulged in, the character, the imagination, and the whole mental existence in a way that is unmistakable and, so to speak, necessary. These evil effects of onanism seem to us to be greater than those lesser disturbances which seldom affect materially the general health."

A long list of local disorders following excesses in onanism is to be found in the abundant literature of the subject. Löwenfeld (quoted by Schrenck-Notzing) says that in the male the most frequent results are "excessive pollutions (day and night), spermatorrhœa, premature ejaculation in attempt at coitus, hyperæsthesia of the genital centres, spinal neurasthenia, congestion of the prostate, inflammation of the urethra, hyperæmia and swelling of the mucous membranes, and intense sensitiveness of the glans. In young children, besides, there may readily occur vesical tenesmus, wetting of the bed, spasm of the compressor urethræ, and urinary incontinence." Further results are urethritis, prostatorrhœa, spermatorrhœa, and impotence. As secondary results of the neurosis of the lumbar portion of the cord he mentions "general neurasthenia, tachycardia, pains in the eyelids, spasm of the lids, photophobia, or subjective sensations of light, diminution of the acuity of central vision, neurasthenic asthenopia."

In the female masturbation is said to produce neurasthenic disturbances, such as hysterical attacks, paralyses (vesical paralysis), vesical tenesmus and spasm, ovarian neuralgia, weakness of the legs, and spinal irritation. Among alleged local disturbances may be mentioned hyperæmia of the labia minora and the vaginal orifice, desquamation of the vaginal epithelium, fluor albus, cervical catarrh, intense hyperæsthesia, pruritus vulvæ, hypertrophy of the clitoris, and irritable conditions of the uterus and adnexa. Schrenck-Notzing says that "a condition that has thus far been too little studied, and which in its significance is one of the most important and frequent results of masturbation in the female, is a form of impotence in which the orgasm no longer occurs during the sexual act, even when it is performed with several men, but in many cases may be induced *post coitum* by masturbation."

It is not possible here to go into this subject with detail, but it seems to us that in both sexes the act of masturbation, while unquestionably exercising a prejudicial influence on the general character on account of the sense of wrong-doing almost invariably accompanying it and the atmosphere of secrecy and deceit which necessarily surrounds it, cannot in normal individuals be accredited with more than a very small proportion of the evils said to follow in its wake.

In neuropathic children or adolescents, the inheritors of depraved nervous systems or of vicious impulses, it is no doubt far more injurious, but even in them it is open to question whether it is a cause or a symptom of the associated nervous phenomena. An exhaustive investigation was made by one of the writers some years ago into its relation to hereditary nervous and mental disease as seen among criminals. The result showed that the men who had become onanists in a criminal population of eight hundred were classified either as the subjects of mental or physical disease at the time of their admission to prison or as hereditarily predisposed to such disease in the proportion of eighty-five per cent. Among the remainder of the eight hundred only fifty-eight per cent. were so classified. So, too, it was found that fifty-six per cent. of the masturbators had been guilty of one or another of the so-called "crimes of the passions,"—as distinguished from crimes against property,—while a review of the records for fifty years showed that only thirteen per cent. of the whole number of convicts had been convicted for crimes of this character. The evidence, therefore, goes to show that masturbation in great excess is itself a symptom rather than a cause of the various nervous phenomena attributed to it.

As to the ordinary form of masturbation, so common as almost to be called physiological, the views of Sir James Paget seem to us to be wholly correct. He said twenty-five years ago that he believed "you may teach positively that masturbation does neither more nor less harm than sexual intercourse practised with the same frequency with the same conditions of general health and age and circumstance. Practised frequently by the very young,—that is, at any time before or at the beginning of puberty,—masturbation is very likely to produce exhaustion, effeminacy, over-sensitiveness, and nervousness, just as equally frequent copulation at the same age would probably produce them. Or, practised every day, or many times in one day, at any age, either masturbation or copulation is likely to produce similar mischiefs or greater. And the mischiefs are especially likely or nearly sure to happen, and to be greatest, if the excesses are practised by those who, by inheritance or circumstances, are liable to any nervous disease, to 'spinal irritation,' epilepsy, insanity, or any other neurosis. But the mischiefs are due to the quantity, not to the method, of the excesses; and the quantity is to be estimated in relation to age and the power of the nervous system. He has seen as numerous and as great evils consequent on excessive sexual intercourse as on excessive masturbation; but he has not seen or heard anything to make him believe that occasional masturbation has any other effects on one who practises it than has occasional sexual intercourse, or anything justifying the dread with which sexual hypochondriacs regard the having occasionally practised it."

Treatment of Onanism in Children.—In the absence of inherited neuropathy, onanism in very young children is usually an automatic act, resulting from some persistent local irritation.

Phimosis, balanitis, vesical calculus, and urethral polyp are common causes of sexual excitation in male children, producing the custom of handling or pulling at the penis, which after a time results in a fully formed onanistic habit.

Masturbation in young female children is far less common than in males. Eczema and pruritus vulvæ, seat-worms, and other causes of irritation about the genitals or the anus are the most common etiological factors.

In both sexes irritation from diapers or from tightly fitting clothing may favor the continuance of the habit.

Obviously the treatment of such cases is to be directed towards the removal of the cause. Circumcision should be performed, regardless of the condition of the foreskin, in all children who have this habit.

Even if it is not very long or tightly adherent, its removal lessens the sensitiveness of the region of the glans and the frænum. The psychical effect of the operation itself, if the child is three or four years of age or older, has a powerful deterrent influence. Of course vesical calculi should be removed, eczema cured, and the other pathological conditions mentioned should receive appropriate treatment.

Intelligent parents can be of great assistance in breaking up the habit. The individual management of the child must be determined by his peculiarities of disposition and temperament. With some children, even while they are very young, a few words of caution or advice are effectual. With others some form of punishment is required. Occasionally it may be necessary to apply a vesicant to the genitals, so as to leave a denuded spot which will be painful enough to prevent handling of the part.

Attention should be paid to the condition of the urine. An excess of uric acid, oxaluria, a very acid or concentrated urine, may furnish the necessary stimulus to the performance of the act.

The diet, especially the evening meal, should be light and simple. Constipation should be carefully avoided. An enema of cold water at bedtime, followed by the insertion of a white wheat gluten suppository into the rectum, will often be found of advantage.

Open-air exercise to the point of fatigue is indicated in the majority of cases. Drugs should be avoided.

Treatment of Onanism in Adolescents and Adults.—In all cases of persistent masturbation, at whatever age, the same general line of treatment as that outlined above should be followed. The conditions that are provocative of the act in young children may cause its continuance after puberty. In males circumcision is especially to be recommended, the patient being told that the operation is necessitated by his previous indulgence in the vice, and that it will prove curative. Cold bathing, a simple natural life, a plain diet, plenty of exercise, and avoidance of social and, of course, of sexual excitements, are the main points to be observed as to the hygiene of such patients.

The use of full-sized cold steel sounds introduced twice weekly, and left in the urethra for from ten to fifteen minutes, instillations of fifteen to twenty drops of a one per cent. silver nitrate solution into the prostatic urethra, and counter-irritation to the perineum, are the chief therapeutic measures.

As to the general advice to be given such patients in regard to their sexual relations, while we agree with those who think it improper to advise fornication, and believe it is almost equally inadvisable to recommend marriage as a mode of treatment, yet we must dissent from the opinions which have been expressed by many of the most distinguished men in the profession as to the harmlessness of enforced chastity. Sexual abstinence, when entirely voluntary and spontaneous, and practised without thought or mental struggle on the part of the patient, is doubtless harmless. But it seems to us equally beyond doubt that the continence which is the result of fear of wrong-doing or of dread of social disgrace or of physical disease, and which is attended with continued sexual excitation and constant hyperæmia of the genital organs, is harmful. We believe that every-day clinical facts abundantly demonstrate the truth of this assertion, if they are studied without prejudice or preconceived theory. It does not follow that a remedy can be suggested. It is highly probable that the evils which certainly result from continence in some individual cases are far less than those which would result from promulgation of the doctrine that "the idea of complete health includes complete and regular satisfaction of all the needs of man, and that is the goal for which hygiene must strive, and not seek to stifle one of the most important functions of the organism, like the sexual instinct. The recommendation voluntarily to destroy any function like the idea of love is a subject for the fanatic, but directly opposed to hygiene." (Tarnowsky.)

Von Schrenck-Notzing, writing of prostitution, says, "The limitation of the evil to a minimum, which seems to every one of any knowledge of the subject both desirable and attainable, with any prospect of relative success, can only be brought about through an inner reform of society; through correct education of the young and ignorant; and through an increase of facility of marriage and amelioration of conditions of life. 'For the more undeveloped an individual is, the more reckless he is in the gratification of his desires.' We should institute a real sexual education, and lead the matured sexual instinct by means of the preservation of rational indulgence into paths devoid of danger; we should make needful concession to the natural impulse; and thus public vice, with its results, the unlimited spread of venereal diseases and the increasing number of crimes against morality, would be greatly diminished and become more and more confined to the step-children of nature (those subject to congenital viciousness). But, more than all, the foundation would be removed upon which rest masturbation and the development of the sexual instinct in perverse directions."

Continuing, he adds, "The strength and intensity of the sexual instinct, like moral and physical individuality, are too various to make it necessary to give a general application to the foregoing statements.

Such a misunderstanding might become a welcome license and cloak for all possible expression of vice, and it would open the door to sensuality. While one, thanks to the inherent peculiarities of his organization, can easily practise abstinence, another is led to onanism, and, as a result of it, is utterly ruined if he has no opportunity for natural sexual indulgence."

We believe, as we have already said, that the patients "utterly ruined" by onanism are very few, but it must be admitted that even in the cases in which it is a symptom rather than a cause of disease normal sexual relations are greatly to be desired for the patient.

In the present constitution of society individuals must suffer. We cannot follow either in theory or in practice the further teaching of Notzing, who says, "The chaste youth should exercise sexual abstinence as long as he is able to restrain the instinct without injury to his health. Should he be in danger, owing to increasing strength of his sexual impulse, of onanism, of falling a victim to satyriasis or perverse sexual indulgence, then it becomes the duty of his teacher and his physician to cause indulgence in coitus, and also to acquaint the neophyte with precautionary measures which will guard against excesses, infection, and the procreation of illegitimate offspring, which, under certain circumstances,—*e.g.*, with contrary sexuality,—may be hereditarily tainted. Individual sexual capabilities should determine the frequency of sexual indulgence. It is impossible to fix a normal standard."

We do not believe that it is customary in this country to give advice of this character, and we think the resultant evils, if this should become a common professional practice, would far outweigh the advantages, but we must reiterate that the contrary teaching as to the invariable harmlessness and even benefit of sexual continence is unscientific, and is opposed to many easily observed clinical phenomena.

Satyriasis and Nymphomania.—In these cases the sexual desire is so overpowering that its gratification becomes the one dominant thought and purpose of the patient's life. The condition may be spasmodic with remissions, or, in bad cases, may be almost continuous. It is favored by any form of genital irritation, but the essential factor is some cerebral disturbance or degeneration which results in a diminution or abolition of the will-power. Magnan locates these lesions in the sensory regions of the cortex which lie behind the central convolutions, where, according to this author, "the zone of the desires and instincts lies, and which are influenced quasi-automatically by the genito-spinal centre as soon as the forebrain for any reason ceases to act."

It may in some cases be a reversion to ancestral instincts. In many of the lower animals during the rutting season the sexual impulse becomes so powerful as to dominate all other desires and habits and render the individual insensible to dangers ordinarily carefully avoided.

Women are said to be more subject to this form of sexual perversion than are men. Whether this is true or not, there can be no doubt that, since women have less sexual need than men, a predominating sexual desire in them should arouse more early a suspicion of its having some pathological significance.

Krafft-Ebing says that "the central origin of sexual excitement is of frequent occurrence in persons having a neurotic taint or hysteria, and in conditions of psychical exaltation. Here, where the cortex and the psycho-sexual centre are in a condition of hyperæsthesia (abnormal excitability of the imagination, increased ease of association), not only visual and tactile impressions, but also auditory and olfactory sensations, may be sufficient to call up lascivious concepts."

Magnan (*op. cit.*) reports the case of a young woman who had an increasing sexual desire from puberty, and satisfied it by masturbation. Gradually she grew to become sexually excited at the sight of any man pleasing to her, and, since she was unable to control herself, she would sometimes shut herself up in a room until the storm had passed. At last she gave herself up to men of her choice, that she might get rest from her tormenting desire; but neither coitus nor masturbation brought relief, and she went to an asylum.

The case is added of a mother of five children, who, in despair about her inordinate sexual impulse, attempted suicide, and then sought an asylum. There her condition improved, but she never trusted herself to leave it.

It is obvious that in such patients the sexual symptoms are only part of a general disease, probably cerebral in almost every instance.

They are acute manifestations of a more or less chronic degenerative process, which later will nearly always show itself by some form of paresis or paralysis, or by mania or dementia.

Krafft-Ebing says, "There are also cases that, not without reason, might be called chronic satyriasis or nymphomania. To these belong the men who, for the most part as a result of abusus veneris, or more particularly of masturbation, suffer with neurasthenia sexualis, and at the same time have intense libido sexualis. The imagination, as in acute cases, is in a state of excitement and the mind full of obscene images, so that the most elevated ideas are besmirched with the most cynical images and thoughts. The thought and desire of such men are solely directed to the sexual sphere; and since their flesh is weak, led on by their fancy, they come to indulge in the grossest perversions of the sexual act. Analogous cases in women may be called chronic nymphomania. They naturally lead to prostitution."

In all these cases the genito-urinary surgeon may be of use in removing every source of peripheral irritation, an important element of treatment, as it renders more easy a restoration of the balance between desire and will-power.

Sexual Anæsthesia.—The ordinary forms of impotence, or inability to perform the sexual act, in the male are among the manifestations of sexual anæsthesia, and are described in Chapter XXI.

The corresponding forms of impotence in women are less frequent, so far as the profession has any reliable knowledge of the subject. The most common variety is said to be that in which failure of the female to secure orgasm during the sexual act is owing to premature ejaculation on the part of the male,—premature, that is, in relation to the woman's requirements. This appears to be due in a large proportion of cases to a degree of sexual coldness which is not overcome by the ordinary mechanical excitation of the parts, and may result from either physical or psychical conditions.

Among the former is to be noted disproportion between the genital organs of the two individuals, as in cases of abnormally small development on the part of the male or of unusually large and relaxed genitalia on that of the female. Exhaustion of the sexual centre from long-continued uterine or ovarian irritation, neurasthenia, and vaginismus should also be mentioned. Emotional conditions are among the chief psychical causes of impotence in the female,—the fear of pregnancy, or of disease, or of discovery, when the intercourse is illegitimate; the lack of affection, or of some of the sentimental concomitants of the act, when it is performed maritally.

It is obvious that in the management of these cases the tact and intimate personal knowledge of the regular medical attendant are likely to be of far more use than any surgical or gynæcological procedures, which must be limited to the removal of obvious sources of irritation and of any mechanical impediments to intercourse.

The foregoing conditions barely fall within the limits of sexual psychopathy, but there are more marked examples of sexual anæsthesia in both sexes in which the absence of sexual instinct seems to be absolute and to depend upon central causes.

Krafft-Ebing says that these functionally sexless individuals are seldom seen, and are, indeed, always persons having degenerative defects, and in whom other functional cerebral disturbances, states of psychical degeneration, and even anatomical signs of degeneration, are observed. With such patients there is even less opportunity for treatment, which should in any event be directed by the neurologist or alienist.

Sexual Paræsthesia.—In all its forms this condition involves a perversion of the sexual ideas with relation to the individual. The perversion may be—1, heterosexual, with abnormal and distorted activity of the sexual impulse, or, 2, homosexual.

1. ALGOLAGNIA (*algos*, pain; *lagnos*, lust).—In the heterosexual varieties of the disease—*i.e.*, those in which an inclination to intercourse with the opposite sex exists—the perversion may take the form of associating acts of cruelty and violence with the act of coitus. When such acts are directed by the patient against another person the disease is known as *sadism* (active algolagnia). This is not infrequent, especially with males. It is explained on the theory that the two emotions of lust and anger both throw the psychomotor sphere into a state of extreme excitation, causing an impulse to react in every possible way on the object that supplies the stimulus. In neuropathic individuals this impulse becomes uncontrollable and leads to mutilation or murder. The disease is more frequent in males because to them belongs the aggressive *rôle* in sexual life, and their sexual relations have always involved the overcoming of obstacles. In the presence of pathological conditions this aggressiveness, usually physiological, becomes uncontrollable and leads to various monstrous and unnatural crimes.

The Whitechapel murderer is in all probability an example of the most extreme form of sadism. A minor form is illustrated by one of Tarnowsky's cases. The patient was a physician of neuropathic constitution reacting badly to alcohol. Under ordinary circumstances capable of normal coitus, as soon as he indulged in wine he found that his increased desire was no longer satisfied by simple coitus. In this condition he was compelled to prick the nates puellæ or to make stabs with the lancet, to see blood and feel the entrance of the blade into the living body, in order to have ejaculation and experience complete satiety of his lust.

Cases exemplifying a great variety of forms of sadism have been published in detail, but it is probable that they differ only in degree from those in which the abnormal impulse is satisfied by biting, scratching, or light flagellation to those in which the patient becomes a veritable monster, sucking the blood or eating the flesh of his victim.

Masochism (passive algolagnia) is the converse of sadism. The abnormality manifests itself in a desire to suffer and be subjected to violence and cruelty. It might be expected that for similar physiological reasons to those which explain the greater frequency of sadism in males, masochism would be found far more frequently in females, whose normal instincts lead towards sexual subjugation and submission. But except in very rare instances the restraints of custom and of modesty have been sufficient to prevent women from giving noticeable expression to this form of sexual perversion, which probably often constitutes an unobserved stage of mental disorder shown later in other ways.

In men masochism is frequent, large numbers of cases having been reported in great detail. It is usually less serious in its consequences than is sadism.

" In masochism there is also a gradation of the acts from the most repulsive and monstrous to the silliest, in accordance with the degree of intensity of the perverse instinct, and the power of the remnants of moral and æsthetic motives that oppose it. The ultimate consequences of masochism, however, are opposed by the instinct of self-preservation, and therefore murder and serious injury, which may be committed in sadistic excitement, have here, as far as known, no passive equivalent in reality; but the perverse desires of masochistic individuals may, in imagination, attain these extreme consequences." (Krafft-Ebing.)

For example we may cite the case of a middle-aged man, married, and the father of a family, who had always led a normal sexual life, but who came of a very nervous family. In his early youth he was powerfully excited sexually at the sight of a woman slaughtering an animal with a knife. From that time, for many years, he revelled in the lustfully colored idea of being stabbed and cut and even killed by women with knives. Later, after the beginning of normal sexual intercourse, these ideas lost completely their perverse stimulus for him.

Rousseau appears to have been a masochist, and, according to Lombroso, Baudelaire belonged in the same class.

2. HOMOSEXUALITY, or contrary sexual instinct, is a form of sexual paræsthesia which is among those most commonly observed. A large number of varieties have been noted and classified, but the symptom common to all of them is the existence of sexual desires and instincts exactly opposite to those characteristic of the sex to which the patient belongs. The cause of this perversion is unknown. It is probably associated with some inherited central degeneration in the vast majority of cases, though those in which definite external influences

were observable have been classed as "acquired homosexuality," while those in which the perverse instinct appeared spontaneously at or about puberty have been called "congenital."

"In so-called contrary sexual instinct there are degrees of the phenomenon which quite correspond with the degrees of predisposition of the individuals. Thus, in the milder cases, there is simple hermaphroditism; in more pronounced cases, only homosexual feeling and instinct, but limited to the vita sexualis; in still more complete cases, the whole psychical personality, and even the bodily sensations, are transformed to correspond with the sexual perversion; and in the complete cases the physical form is correspondingly altered." (Krafft-Ebing.)

In accordance with this classification the same author describes the following varieties of the disease:

1. Psychical Hermaphroditism.—The characteristic mark of this degree of inversion of the sexual instinct is that, by the side of the pronounced sexual instinct and desire for the same sex, a desire towards the opposite sex is present; but the latter is much weaker and is manifested episodically only, while the homosexuality is primary, and in time and intensity forms the most striking feature of the vita sexualis.

It is thought that such individuals, on account of neurasthenia, of masturbation, or of unfavorable experiences in sexual intercourse with persons of the opposite sex (lack of pleasure, weakness of erection, premature ejaculation, infection, etc.), may have the homosexual instinct strengthened, and after satisfying the impulse by passive or mutual onanism with a person of the same sex, or by *coitus inter femora*, may pass into the second group.

2. Urnings.—In distinction from the preceding group of psychosexual hermaphrodites there are here, *ab origine*, sexual desires and inclinations for persons of the same sex exclusively; but, in contrast with the following group, the anomaly is limited to the vita sexualis, and does not more deeply and seriously affect the character and mental personality. (Krafft-Ebing.)

The patients belonging in this class have a disgust for coitus with persons of the opposite sex. Their affections are apt to be emotional and passionate; they present all the phases of sentimental attachment to persons of their own sex that are seen in normal individuals only between males and females. They are usually unable to have intercourse successfully in a normal manner, partly because the act of coitus is inhibited by their emotional condition. In men of this class mutual masturbation and often pederasty afford sexual gratification; in women, mutual masturbation in one form or another.

3. Effemination and Viraginity.—In this class not only the sexual instincts but all the feelings and inclinations are reversed. The men are females in habits, sentiments, and character; the women, males. In such cases heterosexual love is looked upon as incomprehensible, and sexual intercourse with a person of the opposite sex as impossible. In homosexual intercourse the man always feels himself, in the act, as a woman; the woman, as a man. The means of indulgence, in the case of a man, where there is irritable weakness of the ejaculation centre, are simply *succubus*, or passive *coitus inter femora;* in other cases passive masturbation, or *ejaculatio viri dilecti in ore proprio.* Many have a desire for passive pederasty; occasionally a desire for active pederasty occurs. The sexual satisfaction of the female probably consists of *amor lesbicus*, or active masturbation.

4. Androgyny and Gynandry.—In this most extreme variety of homosexuality not only are the character and the feelings sexually reversed, but also the form, the features, and the voice, so that the individual approaches the opposite sex anthropologically and in more than a psychical and psychosexual way. This anthropological form of the cerebral anomaly apparently represents a very high degree of degeneration; but that this variation is entirely different from the teratological manifestation of hermaphroditism, in an anatomical sense, is clearly shown by the fact that thus far in the domain of contrary sexuality no transitions to hermaphroditic malformation of the genitals have been observed. The genitals of these persons always prove to be fully differentiated sexually, though not infrequently there are present anatomical signs of degeneration (epispadiasis, etc.), in the sense of arrests of development in organs that are otherwise well differentiated. (Krafft-Ebing.)

It is impossible in this book to pursue this interesting though repulsive subject further. The works so freely quoted in the above outline of sexual psychopathy contain many suggestions as to therapy. The most important of these relate to the prophylaxis of such troubles by early recognition of the neuropathic constitution, the prevention of onanism, and the encouragement of normal or heterosexual impulses even in early youth by regulating the sports and the companions of children. Hypnotic suggestion is being extensively tried in adult cases, but no estimate of its value can as yet be reached.

CHAPTER XXIII.

SYPHILIS.

SYPHILIS is a contagious, inoculable disease, transmissible by heredity. The first lesion of the acquired form of syphilis is a chancre; this is followed by general lymphatic enlargement, by eruptions of the skin, usually superficial and symmetrical and associated with similar lesions of the mucous membranes; later by chronic inflammation and infiltration of the cellulo-vascular tissues, the bones, and the periosteum, and finally by the formation of small tumors called gummata, which may appear in any portion of the body, but which commonly develop in the connective tissue.

Etiology.—Syphilis is almost certainly due to the presence in the system of a specific microbe. A number of bacteriologists have announced the discovery of this microbe, but convincing proof of the direct relation between the micro-organisms described and the specific lesions with which they have been found associated is still wanting. The clinical evidence as to the microbic nature of the disease is, however, fairly conclusive. The languor, pain, and fever preceding the eruption are readily explained on the theory of intoxication by ptomaines engendered by the germs which are not yet sufficiently generalized to produce more pronounced symptoms. The eruptions on the skin and mucous membranes are due to local deposits of the virus; this is shown by the fact that the discharges from such lesions are contagious. The profound alteration in nutrition so often associated with the secondary eruption is due to auto-intoxication by tissue-products passing into the circulation.

Following the secondary stage of the disease there may be no further symptoms of syphilis, or, after a period of latency, gummata may develop. During this period of latency or apparent cure, syphilis may be transmitted to offspring, showing that the active virus is still in the system. This virus or its ptomaines, however, absolutely protect against fresh inoculation. A person who has had syphilis is immune against a fresh attack, positively during the primary and secondary stages of the disease, probably for many years or for the entire period of life. It is true that cases of reinfection are reported, but they are rare; the majority found in medical literature are cases of so-called *relapsing chancre*, in reality a tertiary lesion of syphilis.

Immunity against Syphilis.—It is found impossible to inoculate the syphilitic virus:

1. Upon a person who has already suffered from the acquired form of the disease.
2. Upon a person who has inherited syphilis from one or both parents. (Profeta's immunity.)
3. Upon a mother who has borne a syphilitic child without showing in her own person any of the lesions of acquired syphilis. (Colles's immunity.)

The immunity against fresh infection conferred by acquired syphilis is present in the earliest stages of the disease, usually from the first appearance of the chancre; in some cases even before this. It persists long after syphilitic manifestations have disappeared, and it can be transmitted to offspring independently of the active virus.

These facts show conclusively that the immunity in syphilis, as in other infectious diseases, must be due to the tissue-products of its organized virus passing into the circulation.

Profeta's immunity—namely, that observed in the offspring of syphilitic parents—is noted at times in children who exhibit no signs of hereditary syphilis. Here inhibiting tissue-products without the active virus are present in the circulation. This is also the case in Colles's immunity, in accordance with which the mother of a child syphilitic by its father cannot be inoculated with syphilis. The explanation of this fact depends either on the absorption into the mother's blood through the placental circulation of only the tissue-products of the specific micro-organisms, the so-called antitoxins, or upon the fact that the mother is really suffering from latent symptoms, both the active virus and the tissue-products having been absorbed, but having been so modified by pregnancy that none of the ordinary manifestations of the disease are observed.

Syphilitic Reinfection.—Although, as already stated, syphilitic reinfection is exceedingly rare, it unquestionably occurs in some few cases. In the great majority of those reported the symptoms could be more satisfactorily explained by regarding them as the result of a recrudescence of the original attack. Fournier states that reinfection is certain only when the following conditions can be noted in their proper chronological order:

An indurated chancre with indolent inguinal pleiades; some weeks later, a typical roseola or other syphilitic eruption, cephalalgia, alopecia, or mucous patches; a complete absence of tertiary accidents for some years; finally a new indurated chancre after a suspicious coitus, with characteristic adenopathies, followed, after some weeks, by incontestable secondary symptoms, such as headache, alopecia, mucous patches, typical eruptions of macular or papular syphilodermata, or of other syphilides.

The difficulty in these cases lies in the fact that it is at times impossible to distinguish the primary chancre from the indurated pseudo-chancre. The pseudo-chancres may be divided into:

1. Those which develop, as the result of the spontaneous awakening of the syphilitic virus, at a point where the virus has already manifested its action.

In this case it is sometimes possible, where one has observed this lesion at its *début*, to distinguish it from syphilitic chancre; for, according to the investigation of Fournier, Vidal, and others, it begins by a hardness profound from the first, then becomes excoriated and forms a sore, while the induration of the true chancre is consecutive to the ulceration, or, at most, contemporaneous with it.

2. Those which occur as the result of an extrasyphilitic irritation, —the inoculation of the chancroidal virus, for example, or an outbreak of simple herpes, or the lesion of some form of traumatism. Here the sore has preceded the induration.

Objectively, these lesions may be absolutely identical with indurated chancre. Their ulceration is sometimes deeper, but more excavated and attended with more secretion; these characteristics may, however, be absent.

There is no authentic example of a case of reinfection in a syphilitic who is suffering from secondary manifestations of the disease. Reinoculation practised upon persons presenting the tertiary forms of the eruption has been uniformly unsuccessful.

The Contagion of Syphilis.—The blood of a syphilitic during the secondary period and the secretion from a chancre or from any of the secondary lesions are contagious. The blood may carry contagion after all the inflammatory phenomena of syphilis have disappeared.

Even during the most active stage of the disease the normal secretions, the saliva, the sweat, the milk, and the semen, will not convey the disease, provided they have not mixed with them a discharge from some of the inflammatory lesions. It is possible that in the passage of the serum of the blood through the glandular membranes and cells the contagious particles are strained out.

Although the semen cannot convey contagion, it must contain the virus in some form, since it is able to infect the embryo, and, by this means, the organism of the mother.

After the primary and secondary stages of the disease, both the blood and the discharge from the lesions are innocuous, so far as the conveyance of syphilis is concerned. This condition is generally reached at the end of two years. After three years contagion is almost unknown, and, according to Hutchinson, there is no recorded instance of its having taken place after five years. Nevertheless, inflammatory lesions the result of syphilitic poison may appear for many years after the virus has lost its power of contagion.

Whether contagion be derived from the discharge of a chancre, from that of a mucous patch, or from the blood of a syphilitic, the primary lesion at the seat of inoculation is invariably a chancre.

Except in the hereditary and conceptional forms, a chancre is always the starting-point of syphilis.

Methods of Contagion.—Syphilis has been aptly compared by Hutchinson to the contagious eruptive fevers, such as small-pox and scarlet fever. Like these fevers, it is communicated from a diseased person to a healthy one, and the smallest portion of virus can affect the whole body. It has its stages of incubation, eruption, and decline, and also its sequelæ, the latter not always appearing, and usually being non-contagious; it can be transmitted to offspring, but its sequelæ cannot be so transmitted.

It differs from the other exanthemata in the slowness of its course, in the comparative mildness of its constitutional symptoms, and in requiring actual contact before it can be transmitted. The method of infection is by inoculation or heredity.

The contagion may be either *immediate* or *mediate.*

Immediate contagion—that is, contagion direct from one individual to another—usually takes place during sexual approach, though it may occur from unnatural practices, from kissing, from wounds inflicted by the teeth of syphilitics, or, in the case of medical men, from operating on syphilitic patients, when the hands of the operator are wounded or abraded.

In one case observed in the Out-Patient Department of the University Hospital, a chancre developed at the seat of puncture made in the skin of the lower eyelid for the purpose of sucking out a blood-clot caused by a blow. The man who made suction was suffering from mucous patches of the mouth.

Mediate Contagion.—In this form of contagion the disease is conveyed not by direct surface contact, but by means of spoons, glasses, pipes, clothing, etc., upon which the specific virus is deposited by a person suffering from some of the lesions of syphilis, and from which it is inoculated in some surface break of a person not immune to the disease. The list of articles which have thus conveyed syphilis is comprehensive. Among the frequent carriers of contagion are pipes, cigars, razors, surgical and dental instruments, handkerchiefs and articles of clothing, and human vaccination lymph. Many unusual methods of contagion have been observed.

In one case of Hunterian chancre of the arm the contagion was conveyed through a slight scratch by means of a towel. Melot reports a nasal chancre developing in a pedestrian who was accidentally hit by the whip-lash of a passing teamster. The latter, who was syphilitic, had formed the habit of biting his lash.

Types of Syphilis.—Syphilis may begin and end with chancre and inguinal adenitis, no other symptoms developing. Under these circumstances doubt may reasonably be entertained as to the nature of the original sore. It has, however, been proved beyond contradiction that after such a sore and the entire absence of secondaries unmistakable tertiary lesions may appear years later, and it seems reasonable to conclude that infection may exceptionally be so mild that it is sufficiently overcome by systemic resistance in its primary stage to prevent the secondary efflorescence.

The disease may have for its manifestations a chancre, general adenitis, and one light outbreak of macular or papular eruption involving the skin and the mucous surfaces of the mouth and throat, thereafter showing no signs.

More commonly following the chancre there is a single exanthematous outbreak, disappearing promptly under treatment, but recurring occasionally, particularly in the mouth and throat. These recurrences yield promptly to more vigorous antisyphilitic treatment, and are not followed by tertiaries. The types of disease thus described are termed benign, but any of them may be followed by tertiary manifestations of the most dangerous and incurable form.

Exceptionally the disease is distinctly atypical in its development, deep ulcerating and infiltrating lesions appearing in the early secondary period. In these cases syphilis may assume a malignant type.

This form of the disease is characterized by its acute course. Even the chancre exhibits a destructive tendency, resembling in its development phagedenic chancroid. Syphilitic fever, concomitant rheumatism, and anæmia are well marked. The first eruption quickly becomes pustular, and ulcers form which are deep enough to leave pigmented scars on the skin, and in the mouth and nose to involve the superficial bones and cartilages, causing necrosis and deformity. Deep ulcers and ulcerating gummata appearing in the secondary period are especially characteristic of this form of syphilis. Recurrences following hard upon one another are also typical of malignant syphilis, while early involvement of the bones, the nervous system, and the viscera is not uncommon. In the latter case syphilitic marasmus and death often result.

The malignant form of the disease seems to depend not so much upon the virulence of the infection as upon the lessened tissue resistance. Thus, syphilis is prone to exhibit its malignant form in the weak, the anæmic, chronic drunkards, the scrofulous, the tuberculous, the malarial, and in pregnant or nursing women.

Periods of Syphilis.—In accordance with its clinical course the phenomena of acquired syphilis are classed under certain periods. These are as follows:

1. *The Period of Primary Incubation.*—The time intervening between exposure to contagion and the appearance of the chancre. This is, on an average, three weeks.

2. *The Period of Primary Symptoms.*—The chancre develops and the anatomically related glands become enlarged. This period, on an average, is from three to ten days.

3. *The Period of Secondary Incubation.*—The time elapsing between the appearance of the chancre and the development of secondary symptoms. This is, on an average, about six weeks, and includes, of course, the period of primary symptoms.

4. *The Period of Secondary Symptoms.*—Syphilitic fever, anæmia, neuralgic pains, and the syphilides of the skin and mucous membranes develop during this period. This is, on an average, from twelve to eighteen months.

5. *Intermediate Period.*—During this time the patient may be entirely free from any signs of syphilis, or he may suffer from slighter, more irregular, less symmetrical, and less generalized symptoms than those of the secondary stage. Children begotten by a patient in the first half of this stage of the disease often show the signs of hereditary syphilis. This period lasts from two to four years. It may terminate in complete recovery or may be followed by:

6. *The Period of Tertiary Symptoms.*—This is characterized either by the formation of gummata or by diffuse infiltration of various organs. Chronic periostitis and ostitis, skin diseases of the tuberculo-ulcerous type, disease of the nervous system, etc., are encountered during this stage. In the majority of properly treated cases the lesions of this period never appear; though they may develop at any time subsequent to the chancre, they commonly are seen in the third and fourth years following the primary lesion.

It must be understood that this division of syphilis into periods is to an extent artificial, there being rarely any sharp limitations; one period runs insensibly into another. Indeed, it is possible that lesions of primary, secondary, and tertiary syphilis may all be present at the same time.

The Period of Primary Incubation.—In a person exposed to contagion the lesion of syphilis does not develop immediately. Although there is little reason to suppose that the virus of syphilis remains localized during the entire period elapsing between inoculation and the appearance of the chancre, it is probable that it remains at or near the seat of inoculation a certain length of time, and hence if immediately removed by caustic applications or by surgical operation, local and general symptoms of syphilis will not follow. There are cases on record, however, which seem to disprove this. Abrasions through which the virus might have been absorbed have been cut out a few hours after suspicious connection, and yet characteristic induration and secondary symptoms of syphilis have developed at the regular time. It is, of course, possible that excision in these cases was not sufficiently thorough. Such instances show that even after very early removal the prognosis concerning subsequent disease must be exceedingly guarded.

It is possible that syphilis may be acquired from contact with the virus through unbroken surfaces, especially where the epidermis is extremely thin; but the presence of fissures or of abrasions greatly facilitates the contraction of the disease.

As has been said, from whatever source the contagion is derived, a chancre at the point of inoculation is the invariable result.

The period of primary incubation varies from ten days to three months. The average period is three weeks. As a rule, it is safe to assume that any sore which appears more than ten days after the last exposure to contagion is a chancre. During the period of primary incubation there are neither general nor local symptoms.

THE PERIOD OF PRIMARY LESION.

After the period of primary incubation the primary lesion of syphilis, a *chancre*, develops. This begins as a spot of erythema, which in a few hours becomes a superficial papule; it gradually extends in circumference and depth, loses its epithelial or epidermic covering, and in the course of a few days is surrounded by an area of induration. This represents the development of a typical chancre. Frequently, however, the chancre when first seen appears as a fissure or an abrasion, or, if located on the mucous membrane, as a superficial ulceration covered by a grayish or yellowish false membrane.

Often there is no break in the continuity of the epidermis overlying a chancre, but merely a gradual thinning of this layer of the skin from the margins towards the centre.

When actual ulceration exists it forms a simple cup-shaped depression, with sloping margins and smooth surface, in the centre of which is a false membrane; beneath this there is a granulating surface, which bleeds readily on mechanical interference.

As synonymes for chancre the following terms are employed: *Hunterian chancre; infecting chancre; hard chancre; indurated neoplasm; primary sore.*

The chancre is usually *single.* When the virus has been inoculated at the same time in several places a number of sores may appear, but they all develop at the same time, and are never due to inoculation of surrounding or apposing surfaces with the discharge of a first sore. Multiple chancres occur in eighteen per cent. (Fournier) of cases.

Induration.—In from five to ten days the most characteristic feature of chancre, the induration, becomes perceptible; it commonly reaches its maximum in about two weeks from the appearance of the chancre. In some cases the induration is entirely absent. It is present and distinct in the great majority of cases, but may appear in different forms. This hardening about the primary lesion of syphilis is due to a cellular infiltration of the connective tissue and of the coats of the venules and arterioles, affecting chiefly the tunica adventitia of the latter. It is the thickening of the blood-vessel walls which, in conjunction with the cellular infiltration, gives to the chancre the specific induration.

The blood-vessels of the skin form two horizontal net-works,—one beneath the papillæ, the other in the deepest portion of the derm. When only the superficial net-work of vessels is sclerosed there is simply a surface induration; when both net-works, together with the intermediate branches, are affected, there is a distinct nodule, varying in thickness according to the extent of skin surface involved. Nearly always the vascular sclerosis is continued far beyond the area of induration, but usually in such a comparatively slight degree that the line of demarcation between the borders of the chancre and the surrounding tissue is distinctly marked.

In accordance with its depth the induration is classified as follows:

1. *Laminated Induration.*—The hardening around the lesion, though distinctly outlined from the surrounding tissues, forms a layer so thin that it gives to the examining fingers a sensation as if a disk of writing-paper had been inserted in the superficial layers of the skin.

2. *Parchment Induration.*—This is somewhat thicker than the lam-

inated induration, giving on palpation such a sensation as would be conveyed were the lesion placed upon a disk of parchment.

3. *Nodular Induration.*—This, in the absence of acute inflammation, is the most characteristic form of induration. It is hard and thick, feeling like a nodule of wood or of cartilage. In well-developed cases of this nature not only the vessels of the skin but also those of the subdermic connective tissue are involved. The hardening is in some cases so great as to suggest the presence of malignant growth.

4. *Annular Induration.*—As is implied by the name, this form of induration affects only the margins of the chancre, a hard ring being formed about the centre, which retains almost normal elasticity.

The induration of the chancre is best detected by gently pinching together the soft parts wide of the lesion till the hardened edges are felt by the thumb and finger placed on opposite sides of the sore; the whole plaque is then lifted upward from the subcutaneous tissues, when, by further gentle pressure and palpation, the depth and extent of the induration can be readily determined.

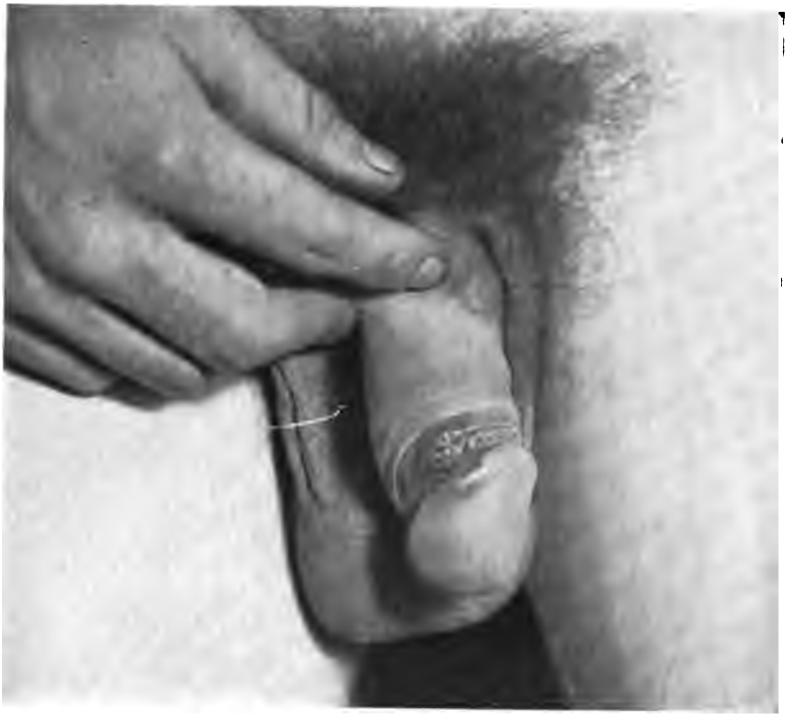
As would be supposed from a knowledge of the cause of induration, the extent of the latter varies in accordance with the seat of the primary lesion. When occurring upon the glans penis, upon the mucous membrane of the prepuce, or in the fossa glandis, the chancre is usually very distinctly indurated. Upon the skin of the penis and the general integument induration is not so marked. In women the induration of the primary lesion is far less distinct than is the case with men; when the chancre is situated upon the labia majora the characteristic hardening is more pronounced than when it involves the labia minora or the fourchette.

The chancre, if ulcerated, commonly heals in four to six weeks, the induration lasting not much longer than this, though, if it has been distinctly nodular in character, it may persist for months and even years, or, after having entirely disappeared, may again become marked, constituting a form of the so-called pseudo-chancre.

Location of the Chancre.—The chancre may be located on any part of the body. Genital chancres are those placed on or about the genitalia. The great majority of chancres, especially in men, are genital or perigenital.

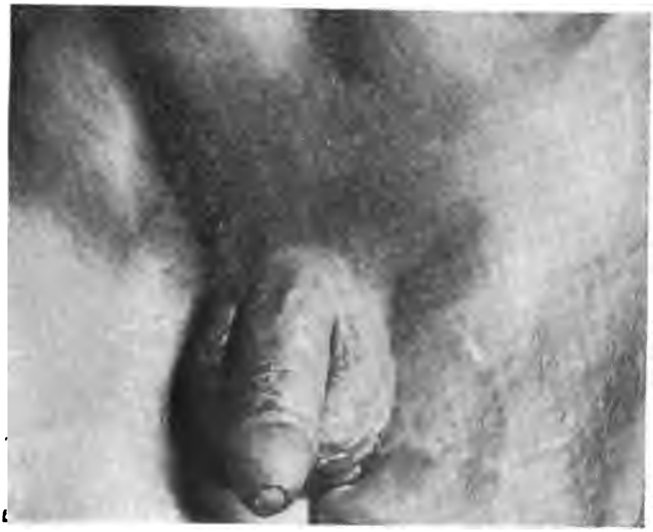
Extragenital chancres are those situated on other surfaces of the body. The disease when acquired in ways other than by normal or perverted sexual congress is termed *syphilis insontium.* The extragenital chancre may be found on any portion of the surface of the body exposed to contact with syphilitic virus. The usual seats of such chancres are the lips, the mucous surfaces of the mouth and

Fig. 255.



Chancre of the reflected layer.

Fig. 256.



Chancre of the meatus.

pharynx, the region of the anus, and the region of the nipple. In the mouth the chancre is commonly found on the tongue, exceptionally on the tonsils or the half-arches. Among surgeons and accoucheurs extragenital chancre is usually found on the fingers or hand. With very few exceptions, extragenital chancres are acquired in innocent ways; even the anal chancres often noted in women are commonly due to infection by discharges flowing backward from the vagina. Extragenital chancres rarely present the typical features of the sore as observed about the genitalia. At times the lesions are so slight as to excite scarcely any attention; more commonly inflammatory symptoms become so pronounced that characteristic induration, if present, is entirely masked, and, except in the clinical history of the case, there is nothing to suggest that the sore is syphilitic in nature.

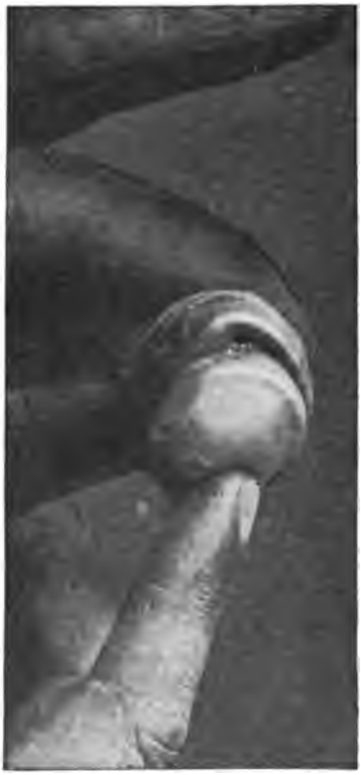
Chancres of the face are often much larger than the average genital chancre, and sometimes form huge ulcers. This is also true of chancres of the lips.

THE GENITAL CHANCRE.

The common position of the genital chancre in men is on the mucous membrane of the prepuce in or just behind the coronary sulcus (Figs. 255–257), on the surface of the glans penis, particularly in the region of the frænum, and about the margin of the preputial opening. Three-fourths of all chancres are in these localities. The primary sore is found at times at the meatus urinarius, on the skin of the penis, on the groin or the scrotum, and in the urethra.

The characteristic induration is most marked in those chancres found at the seats of preference,—*i.e.*, on the mucous membrane of the prepuce just behind the sulcus. Upon the surface of the glans, in the region of the frænum, and about the urinary meatus the induration is often slight, and the sore frequently assumes a distinctly inflammatory type. (Fig. 256.)

FIG. 257.



Chancre of the coronary sulcus.

On the free edge of the prepuce the induration may be absent or may form a ring of great hardness.

In women chancres are commonly placed on the labia majora or labia minora. They are not infrequently found in the regions of the fourchette and the clitoris, and have occasionally been observed about the os uteri. They are rare upon the surface of the vagina, although this canal is probably more exposed to contagion than any other surface. This immunity is due to the structure of the vaginal mucous membrane, which, being guarded with thick layers of flat epithelial cells, and having no glandular orifices, forms an efficient barrier against microbic infection. The inguinal glands are primarily involved only when the lesion is placed in the anterior third of the canal.

As has been said, the induration of chancre is far less marked in women than in men; the typical sharply circumscribed cartilaginous hardening is rarely observed; it is replaced by a more diffuse and less sharply marked infiltration, often very little greater than would attend a non-specific lesion of the same size.

Varieties of the Genital Chancre.—Although the primary lesion may appear in a great variety of forms, the majority of cases present certain characteristic features, enabling them to be considered under a few headings.

In the order of their relative frequency chancres may be classed as:

1. Chancrous erosions.
2. Chancrous ulcerations.
3. Indurated papules.

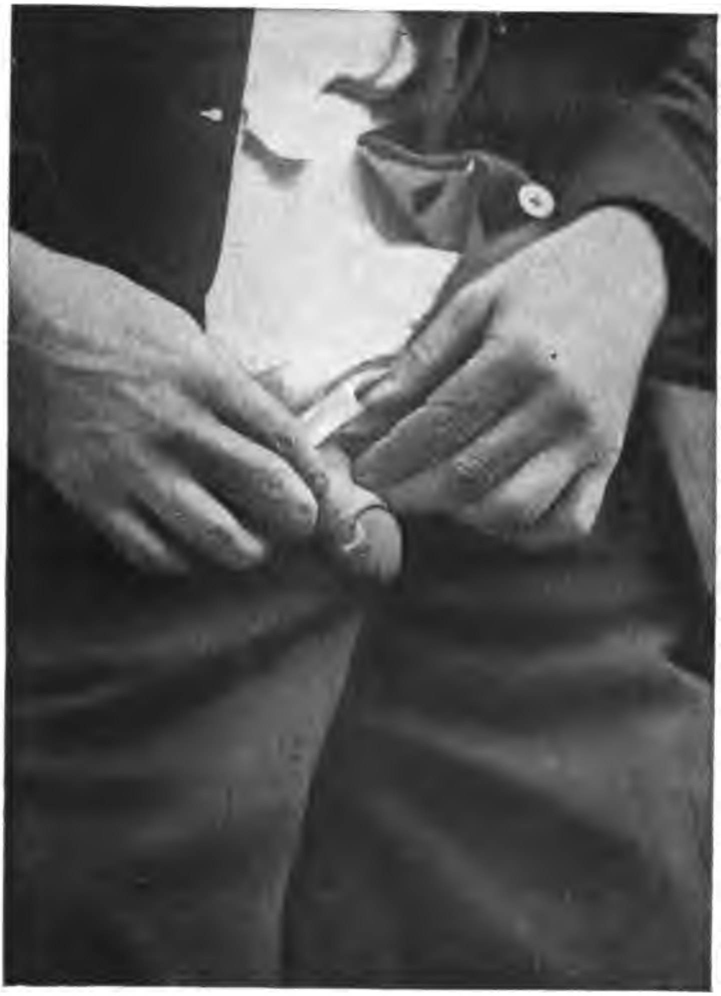
Exceptionally there are observed certain erratic forms of chancre which would not strictly fall under any of these headings. Among these are encountered:

1. The multiple herpetiform chancre, closely resembling herpes, but not presenting the multiple circinate margin of the latter, not giving the characteristic exudation of herpes on pressure, and having a different clinical history.

2. The "silvery spot," a lesion such as would be produced by the application of a finely pointed silver nitrate stick, generally situated on the surface of the glans penis, and often giving place finally to the chancrous erosion.

3. The mixed chancre, a lesion which results from the action of both the chancroidal and the syphilitic virus. The chancroid runs its typical course and may be healed before the syphilitic induration is noted. More frequently there is a persistent chancroidal ulceration, around which the hardening of the true chancre appears at its regular time.

Fig. 258.



Chancre of the corona. (Fox.)

1. THE CHANCROUS EROSION.—About two-thirds of all genital chancres appear in the form of chancrous erosions. The lesion at first looks like a small abrasion, such as might result from a very slight scratch with the finger-nail. As the chancre develops it becomes oval or round in shape, is surrounded by a dusky-red areola, presents a polished raw surface, the central portion of which is covered by a gray false membrane, and discharges a small quantity of blood-stained serum. The lesion is an exfoliation of the epiderm, exposing but not destroying the true skin. The induration develops in about a week from the beginning of the erosion, and is usually parchment-like, though it may be nodular.

2. THE CHANCROUS ULCERATION.—This form of chancre exhibits a deeper ulceration than the chancrous erosion. The latter causes epithelial desquamation; the former involves the true skin, or, in its more exaggerated form, the subcutaneous tissues. The chancrous ulceration may be superficial or deep.

The superficial form of chancrous ulceration, called by Fournier the exulcerative chancre, attacks the true skin, but does not entirely destroy it. An ulcer is formed of moderate depth, with sloping edges and a scanty sero-sanguineous discharge. The granulating surface is frequently covered by a gray adherent false membrane. The induration is more marked than in the chancrous erosion, being rather of the nodular than of the parchment variety. (Fig. 258.)

The deep form of chancrous ulceration, called by Fournier the ulcerative chancre, is comparatively rare. There is formed a deep ulcer with sloping edges, moderate sero-sanguineous discharge, and typical extensive cartilaginous induration into which the ulcer seems to have eaten.

3. THE INDURATED PAPULE.—This primary lesion of syphilis differs from the chancrous erosion in the fact that the skin is not broken. A hard, raised, dusky-red tubercle is formed, sharply defined from the surrounding tissues. The surface is dry, but is frequently crusted with layers of exfoliated epithelium. The papule may be large and prominent, or so small as to escape the notice of the patient.

Complications of Chancre.—The types of genital chancre just described may be so modified that they present an appearance entirely different from that commonly supposed to be characteristic of the primary lesion of syphilis.

The modification may be brought about by: 1, simple inflammation; 2, chancroidal inflammation; 3, papillary growth; 4, conversion into a mucous patch; 5, phagedæna and gangrene.

Simple inflammation may attack a chancre as a result of inoculation with the ordinary micro-organisms of suppuration. This will be more likely to take place if the chancre is exposed to irritating applications, to friction, or to any mechanical injury which will render the soil favorable to the multiplication of pyogenic microbes. The chancre will be modified by the local signs of acute inflammation,—namely, heat, pain, redness, swelling, and free discharge. As a further complication, suppurating buboes may form in the groins.

Chancroidal Inflammation.—The virus of chancroid and that of syphilis may be inoculated at the same time. In this case the chancroid will appear first, and may even have run its course and be completely cicatrized before the characteristic induration of the chancre is noted. More commonly the chancroid persists, the spreading, inflamed, sloughing, punched-out, freely discharging ulcer becoming gradually enveloped in a hardened infiltrate as the period for the full local development of the syphilitic lesion is reached. In place of being acquired at the same time, the chancroidal virus may be inoculated on a well-developed chancre; the result of this will be the formation of a chancroid, the induration being the only remaining local symptom to suggest chancre. If the chancroid spread rapidly it may cause sloughing of the indurated area, in that case leaving no local sign which would suggest syphilis; or the syphilitic virus may be inoculated on the chancroid, the latter then running its course unaltered except for the formation of an induration.

A sore resulting from the inoculation of both syphilis and chancroid at the same spot is called a mixed chancre. It is liable to any of the complications which follow the inoculation of either of the poisons separately.

Papillary Outgrowth and Conversion of the Chancre into a Mucous Patch or Condyloma.—Associated with the chancre there is often an abundant outgrowth of warts, such as are common in balanoposthitis or other inflammatory conditions of the glans and the prepuce. These warts seem to be due simply to irritation, and are not specific in their nature. The chancre itself at times loses its induration as secondary symptoms develop, becomes covered with gray false membrane, and presents all the characteristics of a mucous patch; or the papillary layer of the skin may proliferate, forming a condyloma, a broad, flat elevation, the surface of which is covered with a gray, adherent pellicle.

Phagedæna and Gangrene.—Phagedæna may be regarded as the result of inflammation more rapid and intense than that which characterizes the inflamed chancre. The engorgement becomes so great that there is loss of vitality, and sloughs are formed, or gangrene may attack the tissues. More rarely it progresses slowly, the ulcerating process being then termed *serpiginous*.

Phagedæna is more liable to occur in persons of depressed constitution, yet it is noted at times in the robust. There is undoubtedly a systemic predisposition, which is in many cases successfully combated by specific treatment; the exciting cause is, however, purely local; this is shown by the fact that in the same person one sore may become phagedenic while another pursues an uncomplicated course.

Phagedæna may attack the chancre at any stage of its development, or may complicate any of the secondary or tertiary ulcerations of the disease. If rapid, it destroys the induration more quickly than it can form, and thus removes the most characteristic feature of the chancre.

Diagnosis of Chancre.—Under ordinary circumstances the diagnosis of chancre is comparatively easy, yet it must be remembered that there is no infallible sign, and that the primary lesion of syphilis may present only the features of a simple ulcer. It is safe to refuse to give a positive opinion from the examination of the sore alone.

An opinion as to the nature of a genital sore will be formed after due consideration of the following points:

1. *Confrontation*, or examination of the person from whom the lesion was presumably acquired. Even though he or she is found to be suffering from symptoms of primary or secondary syphilis, it is not proper to conclude that the lesions acquired are necessarily specific. They may be of mechanical, herpetic, or chancroidal origin. This method of diagnosis is rarely practicable in this country.

2. *The History of Incubation.*—A lesion developing in less than five days from exposure is certainly not specific. One developing in from ten days to five weeks is probably specific, unless some other cause, such as mechanical or chemical irritation, or fresh exposure, can be assigned for it.

3. *The Development of the Lesion.*—When this begins as a macule, or slight painless excoriation, or scratch, which persists in spite of careful local treatment, which slowly spreads without marked inflammatory symptoms, which becomes distinctly hard peripherally and at the base as though there were a dense cellular infiltrate, and which gives a thin, scanty discharge, showing a tendency to crust or to form a pseudo-membranous deposit covering the excoriated surface, the diagnosis of chancre can be made with considerable confidence.

4. *Induration.*—When the lesion, be it papule, erosion, or ulcer, develops the laminated, parchment, or nodular induration, a sharply

circumscribed hardening, spreading wide of the central lesion and absolutely unlike the general thickening about an area of simple inflammation, it is almost certainly a chancre.

5. *Lymphatic Involvement.*—If the lymphatic glands of the groin steadily increase in size and hardness, without accompanying pain or other symptom of acute inflammation, forming a chain of little tumors, including several or all of the inguinal glands of both sides, the evidence as to the specific nature of a genital lesion is still further strengthened.

The chief considerations on which a diagnosis is founded are, the period of incubation, the presence or absence of induration, and the condition of the anatomically related lymphatic glands. Even should all these point to syphilis, an absolute opinion should not be given until it is justified by the appearance of some of the constitutional phenomena which in from six to eight weeks follow chancre.

Difficulties of diagnosis are greatest during the first week or ten days, and steadily diminish with the age of the lesion, which, if syphilitic, is almost certain to show the characteristics of the chancre. Confrontation is seldom practicable. The history of incubation is often vague and uncertain, and the development of the lesion is rarely studied attentively by the patient.

Induration is present in the great majority of chancres, and when typically developed is almost enough to justify a positive diagnosis. Induration, however, may fail as a diagnostic sign, since—1, it may be absent or but slightly developed; 2, it may be masked; 3, it may be present in non-specific ulcers; 4, it may be present in relapsing chancres.

1. Lesions absolutely without induration, and yet followed by secondary syphilis, have been reported by competent observers. More frequently the induration is so slight as to be readily confounded with ordinary inflammatory infiltration. Thus the initial lesion sometimes appears as an infecting balanoposthitis, differing from ordinary balanoposthitis only in thickening and hardening of the prepuce, but slightly greater than that observed as a result of simple untreated inflammation; or syphilis may be inaugurated by the multiple herpetiform chancre, which may become indurated to only a moderate degree. On the glans penis the induration is often developed not much more markedly than is common in the case of chancroids.

In the genital chancres of women the induration is, as a rule, poorly developed; it is rare to find in women the typical cartilaginous hardening.

2. Induration may be masked by cellular infiltration dependent

upon acute inflammation attacking a chancre, or may be entirely destroyed by a rapid phagedenic process.

3. Certain non-specific sores may present induration so like that of the chancre that differential diagnosis founded on this sign alone cannot be made. A simple sore which has been treated by caustics will frequently take on induration: hence it should be a rule in examining such cases to ask the patients how they have been treated, and thus avoid attaching too much importance to an apparently characteristic induration. A forming furuncle, the inflamed orifice of a suppurating vulvo-vaginal gland, a tubercular ulcer, may all present a circumferential induration which will make immediate diagnosis impossible.

4. Finally, the so-called relapsing chancre, generally a tertiary lesion, may, with the exception of the inguinal adenopathy, exactly simulate the primary sore of syphilis.

The involvement of the anatomically connected lymphatic glands is absent as a very rare exception, and when typical is highly characteristic. It must be borne in mind, however, that:

1. Many non-syphilitic patients exhibit hard, movable lymphatic tumors in both groins: hence it is important to examine a suspected case frequently, to determine whether or not the enlargement is progressive.

2. Simple sores sometimes cause enlargement of several glands, with very slight inflammatory phenomena. Occasionally, from mixed infection, syphilitic buboes exhibit marked inflammatory reaction.

3. In very rare cases chancre may be followed by secondary syphilis without involvement of the anatomically related lymphatic glands.

The Differential Diagnosis of Genital Chancre.—Since ulcerative lesions of the genitalia may be due to a variety of causes, and since, even though different in their nature, they may present some features in common, the question of differential diagnosis becomes one of great importance.

To distinguish between a "*mixed chancre*" and a *chancroid* or simple venereal ulcer is often impossible. Even should a chancroid be absolutely typical in all its clinical features, it is not safe to make a positive statement that syphilis will not develop. If, in spite of the favorable course of a simple ulcer, after two or three weeks characteristic induration develops, and in another seven days the inguinal glands on both sides painlessly enlarge one after another, the probability of syphilis and chancroid having been inoculated at the same point is great. *Per contra*, if a non-inflammatory indurated sore appears at an interval of more than ten days after exposure, and in consequence of further exposure rapidly assumes an inflammatory type, sloughs, and extends beyond the area of induration, destroying the latter, and presenting on examination only the features of the simple venereal sore, the probability is that the lesion is a mixed chancre, the chancroidal virus having been inoculated upon the primary lesion. This probability is made still stronger if painless multiple enlarged lymphatic glands are found in the groins. Even should a suppurating bubo form, this should not influence the diagnosis in regard to syphilis, since each disease will run its course independent of the other.

The differential diagnosis between chancre, chancroid, and herpes will depend upon a consideration of the characteristics of each as given in the following table:

Chancre.	*Chancroid.*	*Herpes.*
Origin.—Due to inoculation with the blood or lesion-discharges of a syphilitic.	Due to inoculation with the discharge of a chancroidal sore. Possibly caused by pus from other sources.	Due to,— (1) Mechanical irritation, as in sexual intercourse. (2) Chemical irritation, such as is produced by acrid discharges or by uncleanliness. (3) To neuroses; often following fever, and particularly occurring in syphilitics.
Incubation.—From ten days to eight weeks. Average about three weeks.	No definite period. It may not be noticed for two or three days.	None.
Situation.—Generally on the genitalia. Often on lips, nipples, and hands.	Generally on the glans penis and the prepuce. Rarely on other genital surfaces. Hardly ever on other parts of the body.	Generally on the glans penis and the inner layer of the prepuce.
Number.—Single; at times simultaneously multiple.	Frequently multiple, often on apposing surfaces by auto-inoculation.	Multiple. Ultimately often confluent.
Beginning.—Begins as an erosion, papule, tubercle, or ulcer. May remain without ulceration through its entire course.	Begins as a pustule or an ulcer. Always ulcerates.	Begins as a group of vesicles, which may coalesce or may ulcerate singly.

Chancre.	*Chancroid.*	*Herpes.*
Shape.—Round, oval, or symmetrically irregular.	Round, oval, or unsymmetrically irregular, with border described by segments of large circles.	Irregular, circinate borders, representing segments of small circles; sometimes serrated.
Depth.—Usually superficial, cup-shaped or saucer-shaped, or may be elevated.	Hollow, excavated, or "punched out."	Superficial.
Surface.—Smooth, shining, dusky red, glazed; diphtheritic membrane, or scab or epithelial crusts.	Rough, uneven, "worm-eaten," warty, grayish, pultaceous slough.	Bright red superficial granulations, sometimes covered by diphtheritic membrane.
Secretion.—Scanty, serous, hardly ever auto-inoculable, except in cases of mixed infection, when a chancroidal sore may be produced. On squeezing cannot press out a discharge.	Abundant, purulent, readily auto-inoculable.	Moderate secretion, auto-inoculable with difficulty. On squeezing a small serous drop exudes. When this is wiped away, another drop can be pressed out. This can be repeated several times.
Induration.—Almost always present; firm, cartilaginous, or parchment-like; sharply circumscribed; movable upon subjacent parts. Prolonged pressure by the examining fingers does not produce any change in it; usually persistent; disappears under specific treatment.	Only exceptionally present. Due to caustics or other irritants, or to simple inflammation; boggy, inelastic, shades off into surrounding parts, to which it is adherent; disappears soon after cicatrization. Prolonged pressure causes changes in shape, such as are noted in œdema.	Same as local ulcer.
Sensibility.—Very rarely painful.	Often painful.	Often painful.
Course.—Progressively towards cure, the sore often healing spontaneously. Relapses and phagedæna uncommon.	Irregular; may cicatrize rapidly or may extend. Relapses and phagedæna not uncommon.	Easily and quickly cured. Sometimes spreads by the appearance of successive crops of vesicles. Lesions preserve the polycyclic form. Likely to recur, especially in syphilitics and in uncleanly patients with long foreskins.

Chancre.	*Chancroid.*	*Herpes.*
Histology.—A new cell growth. Very little destruction of tissue. Scrapings often show more or less epithelium.	An ulceration, with more or less loss of substance. Scrapings show granulation-tissue.	Originally an elevation of the epidermis in spots by an effusion of serum.
Bubo.—Constant, painless, multiple, generally bilateral.	Appears only in one-third of the cases; painful, inflammatory, single, or a single one on each side.	Rare. When it does occur, painful, inflammatory, single, or a single one on each side.
Prognosis.—Good locally; ulceration is at the expense of the infiltrate: hence there is little ultimate scarring; constitutional syphilis follows in the great majority of cases. In a few it may not appear, or may be prevented from appearing by treatment.	More serious locally, for there is tissue destruction. May refuse to heal or may become phagedenic. Never followed by syphilis (unless mixed).	Always good. Recurrences are frequent, especially in syphilitics. (The herpetic chancre closely simulates herpes.)
Treatment.—Excision when seen early; other purely local treatment is ineffective.	Local treatment is curative.	Local treatment is curative. Tendency to spontaneous cure.

When phimosis is present, so that a lesion of the glans or of the under surface of the foreskin cannot be exposed, it is exceedingly difficult to determine whether such a lesion is chancrous or is due to inflammatory processes of a different nature. In such cases a diagnosis must be made after a consideration of the following points of difference:

Subpreputial Chancre.	*Non-Syphilitic Subpreputial Ulceration.*
Incubation.—Never less than ten days. Usually three weeks; may be more.	*Incubation.*—Really none. Inflammatory symptoms become pronounced in less than ten days.
Number.—The lesion is usually single. (This may be learned from the history of the case before phimosis developed, or from palpation.)	*Number.*—The lesions are usually multiple.
Inflammation.—Acute symptoms absent or but slightly marked.	*Inflammation.*—Acute symptoms very pronounced. (Heat, swelling, pain, redness.)
Swelling.—Hard, characteristic circumscribed induration. Can often be isolated from surrounding tissues and raised and felt between the thumb and finger.	*Swelling.*—Diffuse, œdematous, general inflammatory infiltration. Cannot be isolated or felt as a circumscribed induration.

Subpreputial Chancre.	*Non-Syphilitic Subpreputial Ulceration.*
Discharge.—Moderate, thin, at times blood-stained. Not readily auto-inoculable.	*Discharge.*—Often produces auto-inoculation by accidental contact.
Preputial Orifice.—Not markedly ulcerated.	*Preputial Orifice.*—Almost invariably ulcerated.
Buboes.—Non-inflammatory, bilateral, inguinal buboes always develop.	*Buboes.*—Single, inflammatory, suppurating buboes often develop.

Concealed Genital Chancres.—Typical chancre may develop about the genitalia, yet from the fact that it is so placed as to be concealed from view it may not be observed; thus chancres of the cervix uteri and chancres of the urethra are not usually recognized as such till constitutional symptoms develop.

Chancre of the cervix uteri is probably more common than is generally believed. It is often not discovered because the lesion thus placed produces no pain and but very slight discharge: hence there are no symptoms which would lead a patient to present herself for examination.

The chancre is nearly always situated at the margin of the os, and presents the same variations in size and surface as are noted in primary sores of the external genitalia. It may appear as an erosion, as a deep ulceration with a smooth pseudo-membranous surface, or as a papillary outgrowth. It may be no larger than a split pea, or may present a raw surface the size of the thumb-nail. Induration, though present, cannot be felt, owing to the position of the lesion. Chancre of the cervix must be distinguished from *ulcerating folliculitis*, from *mechanical erosions and ulcerations*, from *herpes*, and at times from *malignant growths.*

Ulcerating folliculitis is commonly associated with a chronic catarrhal condition, and produces small, often multiple lesions, extending very little beyond the limits of the follicle. These lesions promptly heal under appropriate treatment.

Mechanical erosions and ulcerations may closely simulate the specific lesion, but are less sharply circumscribed and do not show the characteristic regular development of the specific sore.

Herpetic lesions can be distinguished from chancre of the cervix by the fact that the former are usually multiple, often coalesce, presenting a circinate margin formed of the segments of many circles, and heal rapidly.

Cancer occurs at an age when chancre is not common; its course is often painful and always progressive. It causes deep ulceration and steadily infiltrates surrounding tissues. If at first glance a chancre resembles cancer, the further progress of the case will shortly decide the diagnosis.

Chancre of the Meatus.—When the sore involves the meatus it looks more like a chancroid than like a chancre. (Fig. 256.) From frequently repeated irritation incident to the flow of urine, the lesions become distinctly inflammatory in type; they are ulcerative and destructive, showing jagged, punched-out borders, and but moderate induration, best detected by taking the end of the glans between the thumb and the forefinger and squeezing it in an antero-posterior direction. Permanent cicatricial deformity is often left after they have healed. Chancre is perhaps more prone to develop at the meatus than is chancroid: hence a sore in this region should be suspected, even though it exhibits none of the clinical features of the syphilitic lesion.

Urethral chancre is often overlooked, not because of absence of characteristic features, but rather because the lesion in this locality is so rare that methodical search is not made for it. As would naturally be expected, the chancre is generally at or near the meatus. It is rarely placed farther back than the fossa navicularis. (See Syphilitic Urethritis.)

EXTRAGENITAL CHANCRE.

Errors or difficulties in diagnosis may arise from the fact that a chancre is extragenital.

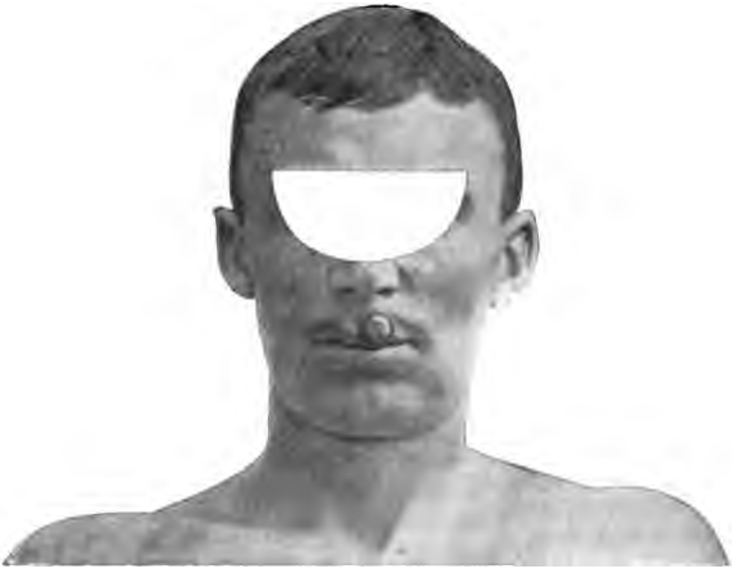
As a rule, chancroid is found only about the genital organs: hence in other regions the question of distinguishing between this sore and chancre rarely comes up. The extragenital lesion is usually single.

Its favorite seats have been given.

Herpetiform erosions of the lips, papules on the tip of the tongue, scabby ulcerations of the skin, scratches which absolutely refuse to heal, chronic inflammations at the tips of the fingers, resembling felons, but without the accompanying acute inflammatory symptoms,—all such lesions should be regarded with suspicion if indolent in course, obstinate to treatment, and accompanied by slight discharge which has a tendency to form crusts or a pseudo-membranous deposit on the eroded surface. If, moreover, such lesions are placed upon an elastic, sharply circumscribed, indurated base, and are followed by hard, painless enlargement of the nearest associated group of lymphatic glands, the diagnosis receives strong corroboration.

Chancres of the Head and Face.—Razor-cuts on the chin, cheek, or lips which, after having healed, reopen and become covered with crusts, pseudo-furuncles or acneiform pustules, and cracks around the mouth or nose which persist, are painless, are surrounded by an area of inflammatory œdematous swelling, and give a thin, blood-stained discharge which exhibits a tendency to form crusts, should suggest the possibility of chancre, and should lead to frequently repeated examination of the parotid and submaxillary lymphatic glands. The primary sore of syphilis when it occurs on the scalp or on the bearded cheeks or chin closely resembles ecthyma. On removing the surrounding and covering hair, a glazed, flat, slightly elevated superficial ulceration is detected. When a patient presents himself with such lesion it is often impossible from the local signs to determine whether or not the sore is specific. The syphilitic lesion begins as a papule or an erosion, which slowly extends, is attended with distinct induration, is never actively inflammatory in type, causes painless enlargement and hardening of the nearest lymphatic glands, and is followed by secondary symptoms. The ecthymatous lesion begins as a flat pustule, surrounded by an acute inflammatory but non-indurated base, is generally multiple, and runs its course in two or three weeks.

Fig. 259.



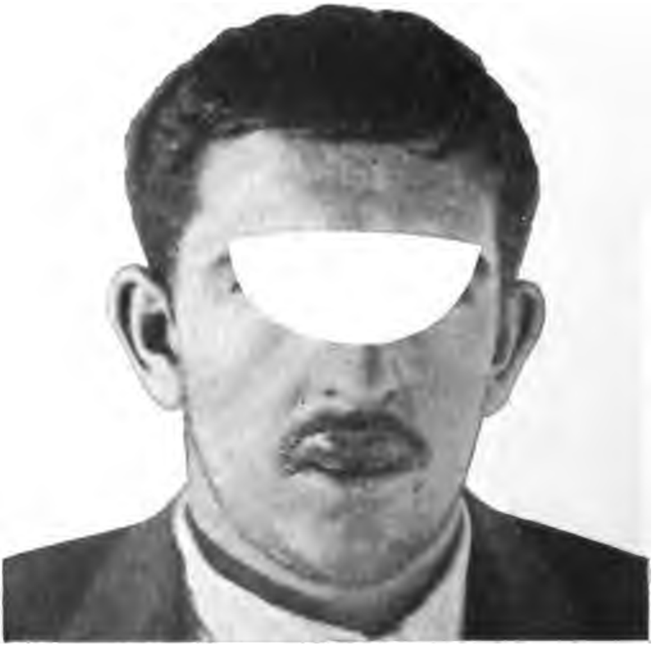
Chancre of the lip.

The eyelids and the ocular conjunctiva may be the seat of primary sore. The lesion begins as a papule, which gradually becomes indurated and eroded or ulcerated, presenting the characteristic sloping edges and hard base of chancre. This lesion has often been mistaken for a stye; its development and the absence of acute inflammatory symptoms would make a correct diagnosis possible in a very few days. Lymphatic enlargement is first noted in the glands in front of the ear and at the angle of the jaw.

At times chancre of the head and face attains enormous size, differing entirely in appearance from the primary lesion of syphilis as ordinarily observed; induration may be absent, and occasionally acute inflammatory symptoms are pronounced. In such cases a positive diagnosis can be made only by recognizing the characteristic lymphatic enlargement and the development of secondary lesions.

CHANCRE OF THE LIP.—As is the case in chancre of other extra-genital regions, chancre of the lip in its beginning closely simulates ordinary non-specific sores. It often begins as a chap or fissure, frequently found in the median line as an aphthous lesion, an herpetic ulceration, or an ulceration such as would be produced by the burn of a cigar or of a cigarette. In the early stage there is nothing characteristic about these lesions, but in a few days the extension of the erosion or ulcer and the formation of a characteristic and usually

FIG. 260.



Chancre of the lip.

very pronounced and extensive induration indicate the nature of the affection. (Fig. 259.) The diagnosis is made still more positive in the course of one or two weeks by enlargement of the submental lymphatic glands.

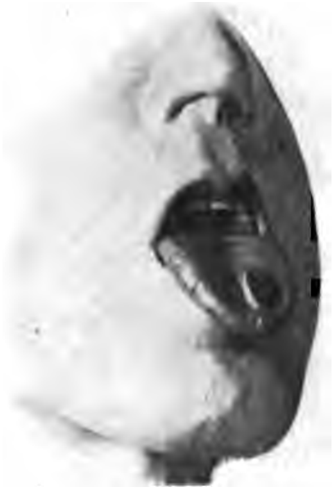
The whole lip is generally congested and swollen, sometimes reaching an enormous size. (Fig. 260.) At times the induration of lip chancre is so great and the ulcerating process so marked that on first inspection it seems to be malignant. The fact that chancres have been excised because they were mistaken for epitheliomata, thus entailing on a patient unnecessary mutilation, justifies a tabulation of the points of difference between the two affections, by a consideration of which the nature of each may be correctly determined.

Labial Chancre.	*Labial Epithelioma.*
History.—Sometimes a history of exposure to syphilitic inoculation.	*History.*—Sometimes a history of cancer in the family.
Age.—Occurs at any age.	*Age.*—Occurs nearly always after middle life.
Sex.—Affects males and females indifferently.	*Sex.*—Hardly ever affects females.
Seat.—Involves either lip.	*Seat.*—Almost always involves lower lip.
Local Symptoms.—A painless elevated sore, regular in outline, with a smooth surface and a sharply circumscribed, dense induration. A scanty, odorless discharge.	*Local Symptoms.*—An irregular, ragged, often painful sore, bleeding easily, and irregularly indurated. An offensive discharge.
Course.—The sore develops in a few weeks at most, often in from seven to ten days. It is followed in one or two weeks by submaxillary glandular enlargements, and in from six to eight weeks by secondary symptoms.	*Course.*—The sore develops very slowly,—a matter of months. The glands are involved only after several months.
Therapeutic Test.—Mercury causes the prompt disappearance of the chancre.	*Therapeutic Test.*—Mercury has no beneficial effect upon the epithelioma.
Microscopic Examination.—The chancre shows a small, round-celled infiltrate, particularly along the course of the blood-vessels.	*Microscopic Examination.*—The epithelioma shows the pearly bodies.

CHANCRE OF THE TONGUE.—The primary lesion of syphilis is less common on the tongue than on the lips. It usually involves the anterior half of the organ, and is found on the dorsal surface, the sides, or the tip.

It commonly assumes the erosive form, presenting an appearance almost identical with that of similar genital lesions. There is simply a painless, oval, or rounded superficial lesion, with smooth surface, frequently covered by a grayish pseudo-membrane seated upon a parchment-like induration. (Figs. 261, 262.) It is often as large as a ten-cent piece. The supra-hyoidean and sometimes the submental glands first exhibit the specific enlargement. Fournier states that when the tip of the tongue is involved, glandular enlargement is at times noted just behind the symphysis of the lower jaw.

Fig. 262.



Chancre of the tongue.

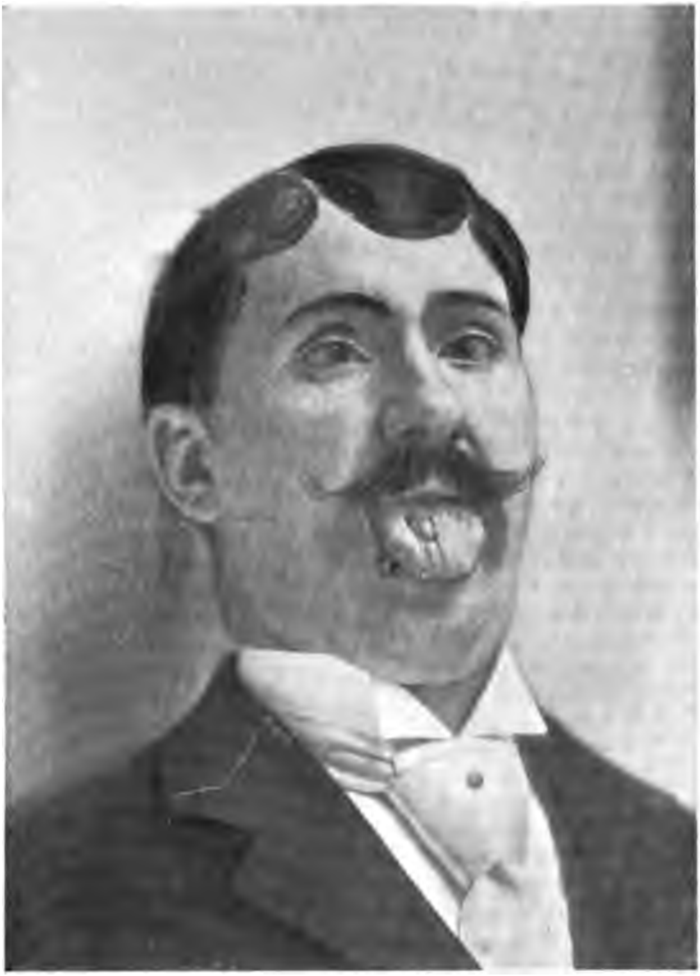
The ulcerative form of lingual chancre exhibits a deep lesion, often upward of an inch in diameter, with sloping edges, and dense, well-marked induration.

However easy the diagnosis may be when the chancre is well developed, in the first stages lingual chancres simulate non-specific lesions so closely that mistakes very readily occur. An early diagnosis is extremely important in such cases, since failure to recognize the syphilitic nature of the disease may result in its transmission to healthy persons. If an ulceration apparently produced by carious teeth, or a papule arising without given cause, fails to heal in five or six days, but, on the contrary, enlarges, becomes elevated, is eroded, is covered with pseudo-membrane, and is not made better by applications of silver nitrate, the lesion may be looked on with great suspicion, which will deepen into almost certainty with the appearance of induration and glandular enlargement.

Chancre of the Tonsils and Fauces.—Chancre is rare in these regions, and when observed is so masked by concomitant inflammatory symptoms that diagnosis is usually impossible. The lesion as described presents the appearance of a mucous patch, which is single, and, if it can be palpated by one finger in the pharynx and the other external to its walls, is found to be indurated. There is a history of prolonged sore throat, and in one or two weeks the glands at the angle of the jaw enlarge.

Primary syphilis of the tonsil is observed in women much more frequently than in men.

FIG. 261.



Chancre of the tongue.
(From the collection of photographs of Dr. George Henry Fox.)

CHANCRE OF THE BREAST.—The lesion is usually caused by a syphilitic infant nursed by a healthy woman: hence it is in women that it is nearly always observed, though a few cases have been reported in men, with a different etiology.

The sore may appear either about or upon the nipple, or upon the skin covering the mammary gland. In the latter case it usually exhibits the characteristic features of chancre as found on the genitalia, being commonly of the erosive or the ulcerative type and rarely offering diagnostic difficulties.

When the lesion is situated on the nipple or at its base, the diagnosis may be a matter of very great difficulty. As is the case with chancre about the nose and mouth, the sore very closely simulates non-specific affections, such as simple fissure, mechanical erosion or ulcer, or even beginning eczema. If, however, a lesion so apparently simple, instead of healing under treatment, slowly extends, if it is accompanied by little or no pain, if it gives a scanty, blood-stained discharge which has a tendency to crust, and, most important of all, if it exhibits distinct induration and painless, non-inflammatory lymphatic enlargement in the axilla, the diagnosis of chancre can be made with some certainty.

Suspicious lesions in a nursing woman should at once suggest an examination of the child she suckles. Secondary lesions in the mouth of the latter would constitute almost positive evidence as to the syphilitic nature of the breast lesions in the woman, provided she is not the mother of the diseased child (Colles's immunity).

CHANCRES OF THE ANAL REGION.—Chancres of the anus are much more common in women than in men. This is due not necessarily to unnatural practices, but rather to the fact that in the dorsal decubitus the vaginal discharges flow downward over the perineum and the anus and thus inoculate the cracks or abrasions which may exist in those regions.

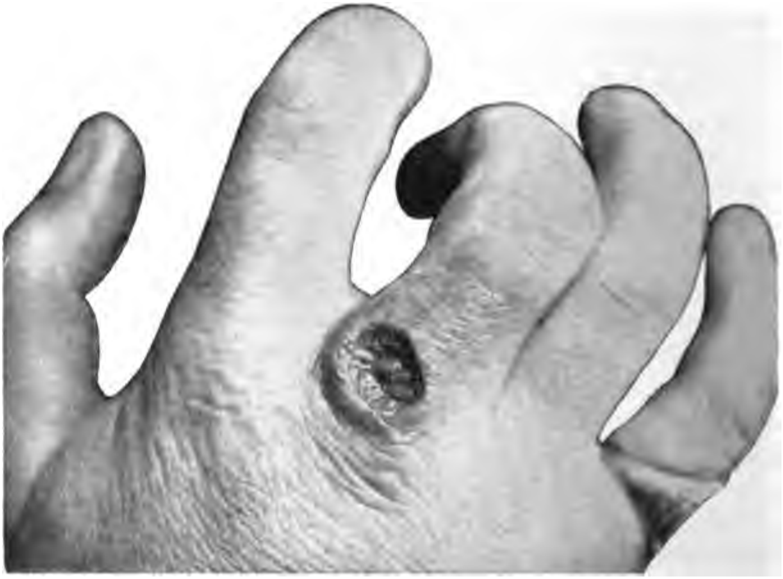
The sore is usually placed at the anal margin, in one of the mucocutaneous folds or puckerings incident to the normal contraction of the external sphincter. The ulceration often follows the line of these folds, thus producing an elongated or linear lesion; this becomes indurated, gives a scanty discharge, is not painful, is refractory to local treatment, and is generally followed by characteristic enlargement of the inguinal glands.

In place of the indurated linear ulcer, an anal chancre may appear as an excoriated papule, or, more rarely, as a typical cup-shaped, densely indurated, ulcerating chancre.

From the appearance of the anal lesion it is sometimes very difficult to determine whether it is a fissure, or a simple ulcer, or the primary sore of syphilis. The slow, progressive development of the chancre, and the absence of pain and of spasm of the sphincter, will indicate the specific nature of the affection, even before induration and lymphatic involvement make the diagnosis almost positive. Chancres of the rectum are exceedingly rare.

Chancres of the Extremities.—Chancre is occasionally observed on the thighs, the anterior surface in men and the posterior surface in women being the regions of preference, on the antero-lateral surfaces of the forearm in both sexes, and particularly on the fingers at the margins of the nails. Occasionally it develops over a knuckle, having been inoculated through a wound caused by a blow on the teeth of a syphilitic. (Fig. 263.) Except on the fingers, the chancre develops in a characteristic manner and offers no special diagnostic difficulties.

Fig. 263.



Chancre of the hand.

Digital chancres commonly appear at the edges or the base of the nail, starting as erosions, papules, or pustules, becoming indurated, elevated, and ulcerated, being accompanied by much swelling of the surrounding finger-pulp, and presenting the appearance of an ulcerating felon.

The chancre, however, develops slowly, gives almost no pain, discharges but little, is not favorably influenced by local treatment, and is shortly followed by epitrochlear and axillary glandular enlargement. When the lesion involves the ring or the little finger, the gland at the elbow, if present, is enlarged; the lymphatics from the thumb and from the index and middle fingers pass directly to the axillary gland.

Sometimes the chancre may develop so insidiously and may form so insignificant a lesion, simply a small indurated papule, that even the patient's attention is not directed to it, and he has no suspicion of having acquired syphilis till the secondary lesions appear.

The early diagnosis of digital chancre is often a matter of very great importance, since a mistake may readily lead to neglect of precautions which would prevent the disease from being conveyed to healthy persons. This is particularly important with doctors and nurses, who form the class in which digital chancres are observed. Any painless lesion about the fingers giving a scanty discharge, steadily enlarging in spite of treatment, and becoming distinctly hard, should excite suspicion, and should lead to the same precautions that would be observed were chancre known to be present.

Vaccination Chancre.—When bovine virus is used, vaccination syphilis from the lymph is an impossibility. When, however, human lymph is employed, this accident has occurred many times. If the vaccination takes, the pustule may run the typical course, and may be healed before evidences of the chancre appear. More commonly the healing of the ulcer resulting from the vaccinal suppuration is delayed; it presents a smooth surface, gives a very scanty discharge, is unattended by pain, and characteristic induration develops. The associated lymphatic glands are enlarged, and secondary symptoms follow.

If the vaccination does not take, there may be no sign of trouble for fifteen to thirty days. Then an indurated papule is formed, which slowly ulcerates and offers all the peculiarities of erosive or ulcerative chancre. Sometimes the vaccination ulcer becomes acutely inflamed, even phagedenic, the inflammatory symptoms thus masking the syphilitic nature of the lesion: simple vaccinal phagedenism may, however, present some of the features of an inflamed chancre. The prompt yielding of the former to local treatment should establish a correct diagnosis in a few days.

The Prognosis of Chancre.—Usually in three or four weeks, sometimes in as many months, the chancres become cicatrized, the induration disappears, and there is left a brownish scar, which may persist for years. This scar may retain its pigmentation as long as it remains perceptible; more commonly it becomes white.

Healing of the chancre will take place spontaneously, but will be greatly accelerated when mercury is administered. Even in extensive ulcerating chancres, such as are observed on the cheeks or the lips, for instance, there is almost no ultimate deformity, since the destruction of tissue is mainly at the expense of the syphilitic infiltrate. If the chancre is attacked by phagedæna,—which is rare,—and if the sloughing process destroys the induration and passes wide of its limits, there may be resultant cicatricial deformity, but this will be due not to the specific poison, but to the destructive influence of other microbes.

Chancre of the conjunctiva may give rise to grave ophthalmia.

Chancre of the tongue or of the fauces may, through interference with mastication or deglutition, cause great debility, and chancre of the urethra is frequently followed by stricture.

The prognosis of syphilitic chancre considered as a local disease is, then, almost uniformly favorable. As to any relation existing between the source of contagion, the chancre, and the constitutional disease of which it is the precursor, the following clinical facts seem well established:

1. It is impossible to predict the form of chancre from the character of the source of infection. It is well known that the most widely differing forms of initial lesion may be acquired from the same individual.

2. The severity of the constitutional disease bears no relation to the form of the initial lesion. A dry papule may be followed by severe secondary symptoms, while an ulcerating chancre may precede a very slight form of constitutional involvement.

3. A short primary incubation followed by unusually well-marked induration and by a short period of secondary incubation shows either impaired resistance of tissues or more than ordinary virulence of the specific poison; accordingly such symptoms denote that the subsequent course of the case will probably be severe.

4. The amount of glandular implication is as uncertain a prognostic guide, in regard to the severity of the constitutional disease, as is the type of chancre.

The *treatment* of chancre is fully described under the abortive treatment of syphilis. (See pages 1005–1047.)

Primary Lymphatic Involvement.—Coincident with the development of the chancre there is a marked alteration in the associated lymphatic vessels (*lymphangitis*) and glands (*lymphadenitis* or *bubo*).

SYPHILITIC LYMPHANGITIS.—In about twenty per cent. of genital chancres there develops usually within the first week, and before the lymphatic glands are involved, a painless, often beaded hardening of the lymphatic vessels of the dorsum of the penis. They form a cord about the size of a match-stick, and may be felt starting from the region of the chancre and running up as far as the inguinal glands, though the hardening does not often extend more than two or three inches along the back of the penis. Unless there is mixed infection, the skin over these lymphatic vessels does not become discolored or adherent; except the induration, there are no signs of inflammation. There may be several of these indurated lymphatic vessels, forming small distinct cords.

The specific lymphangitis usually subsides with the induration of the chancre,—that is, within from three to five weeks; though, like the latter, it may last for several months.

The lymphangitis accompanying extragenital chancres and genital chancres of women can rarely be detected, owing to the less accessible position of the involved lymphatic vessels.

SYPHILITIC LYMPHADENITIS OR BUBO.—The syphilitic bubo is, after the chancrous induration, the most characteristic and constant feature of primary syphilis. As commonly used, the term syphilitic bubo is applied only to those glands with which the lymphatic vessels from the chancre communicate directly. In about a week from the appearance of the chancre these glands undergo a painless enlargement. Since chancres are usually placed upon the genitalia, the inguinal glands are the ones commonly affected. In accordance with the seat of chancre, the bubo will be placed as follows:

Genital and perigenital chancres (including those of the perineum and anus) involve the inguinal glands; chancres of the lip and chin involve the submaxillary glands; chancres of the tongue involve the suprahyoid or submaxillary glands; chancres of the eyelid involve the preauricular glands; chancres of the fingers involve the epitrochlear or axillary glands; chancres of the breast involve the axillary glands.

In genital chancre the gland first affected is usually the nearest one of the chain on the affected side, though when the lesion is situated upon the side of the frænum a gland of the opposite side may first enlarge. Subsequently, one after the other, several of the glands or the entire chain become hypertrophied. This commonly takes place in both groins, though exceptionally it is limited to one side. On examination the glands are felt, each distinct, hard, almond-shaped, painless, and freely movable.

There are often one large gland and a group of from three to five smaller ones, each about the same size. Sometimes but a single gland is enlarged; this is particularly the case with extragenital chancres, such as those of the lip. The enlargement is never very great, the ganglia rarely exceeding the size of a marble. The group of typically indurated glands of the groin has been termed the "pléiade ganglionnaire."

Suppuration occurs in these glands only as a result of mixed infection, the pyogenic microbes gaining access through the surface break caused by the chancre.

In very exceptional cases chancre is not accompanied by syphilitic bubo.

Diagnosis.—Since lymphatic vessels and glands may be enlarged as a consequence of simple inflammation, and since the syphilitic bubo is one of the most important means of diagnosing chancre, it is necessary to bear in mind the points of difference between syphilitic and simple inflammatory involvement of the lymphatics. These points of difference are as follows:

Syphilitic Lymphangitis.	*Inflammatory Lymphangitis.*
Cause.—Always a chancre.	*Cause.*—Chancroids, herpes, or other non-specific lesion.
Symptoms.—A hard, painless cord, unaccompanied by heat, redness, or tenderness. Erection painless. Little or no œdema.	*Symptoms.*—A cord not so hard nor so sharply circumscribed; often painful, especially on erection; tender and accompanied by heat, redness, and œdema of the overlying skin.
Termination.—Undergoes resolution and is uninfluenced by local treatment.	*Termination.*—Undergoes suppuration or resolution. Local treatment effective.

Syphilitic Bubo.	*Inflammatory Bubo.*
Cause.—Always chancre.	*Cause.*—Chancroid, herpes, balanoposthitis, gonorrhœa, or any non-specific lesion.
Number.—Several glands, usually in both groins.	*Number.*—One gland implicated. Rarely bilateral.
Time of Appearance.—Shortly after chancre; about one week.	*Time of Appearance.*—At any time during the existence of a lesion.
Symptoms.—Small, indolent, painless, movable, non-inflammatory tumors, non-adherent to the skin, and of cartilaginous hardness.	*Symptoms.*—A large, tender, painful, acutely inflamed tumor, adherent to the skin, and causing redness and heat of the latter. The hardness is that of inflammation.
Termination.—Resolution.	*Termination.*—Frequently suppuration.
Treatment.—Local remedies without effect. General mercurial treatment hastens resolution.	*Treatment.*—Local treatment curative; general mercurial treatment useless.

The diagnosis of syphilitic buboes from the lymphatic enlargement so frequently noted in strumous patients must depend entirely on the history of the case and the development of the tumors. The strumous adenomata neither increase nor decrease in size unless they become inflamed, in which case they break down and suppurate. A tubercular family history, together with other signs of struma about the patient, can often be elicited; there is no progressive glandular involvement first of the lymphatics anatomically connected with the seat of the sore, then of all the lymphatics accessible to the examining fingers; and finally resolution does not partly or wholly take place in the majority of cases in from two to six weeks, nor is this resolution in the slightest degree quickened by the administration of mercury.

Treatment.—Syphilitic infiltration of the lymphatic vessels and glands usually requires no treatment, subsiding spontaneously soon after the disappearance of the induration of the chancre, though the enlargement of the lymphatic glands may persist for five or six months, or, exceptionally, for many years. The administration of mercury, when the diagnosis has become so certain that its use is justifiable, causes a rapid disappearance of the specific infiltrate. In cases complicated by acute inflammation and suppuration the treatment is the same as that appropriate to chancroidal lymphangitis and bubo.

The Period of Secondary Incubation.—The period between the appearance of chancre and the development of secondary lesions varies from two weeks to three, or even six, months. The average time, however, is forty-two days. The primary lesion often remains during the whole of this period.

The disease, so far as constitutional symptoms are concerned, is apparently quiescent. In reality the virus is becoming disseminated through the entire system, first manifesting its effect upon the accessible lymphatic glands not anatomically connected with the primary sore. Enlargement of these glands usually constitutes the first secondary symptom, and is, except changes in the blood, the earliest positive sign of constitutional syphilis.

CHAPTER XXIV.

CONSTITUTIONAL SYPHILIS.—THE SYPHILIDES.—SYPHILIS OF THE ALIMENTARY CANAL.

Constitutional syphilis includes the period of secondary symptoms, the intermediate period, and the period of tertiary symptoms.

The period of secondary symptoms is characterized by—

1. Alterations of the blood.
2. General lymphatic enlargement.
3. Moderate fever, the temperature reaching 100° to 101° F. in the evening; often associated with malaise and anorexia.
4. Muscular and articular pains, located about the chest, back, and upper extremities, usually moderate in severity, but sometimes very severe.
5. Alopecia, involving the hairy surfaces of the entire body, and causing ragged and irregular bald spots very unlike those incident to the ordinary atrophy of hair-follicles.
6. Eruptions of the skin and the mucous membranes.

Frequently associated with these manifestations are symptoms dependent upon involvement of the eyes, the nervous system, the bones and periosteum, the testicle, and the liver and other glands.

The term secondary syphilis has been applied to those lesions which appear during the first two or three years of the constitutional disease, and which are for the most part superficial; yet it must be remembered that secondary symptoms may never appear, the first manifestation of constitutional involvement occurring after one or two years in the deeper ulcerative form of surface lesions, or in the more serious visceral complications which characterize tertiary or late syphilis. When such deep ulcerative lesions are noted during the period when secondary symptoms should appear,—that is, in the first few months of the attack,—the disease is known as malignant syphilis. Conversely, during the period when tertiary eruptions and visceral complications ordinarily appear, and when such lesions are actually present, lesions particularly characteristic of secondary syphilis may develop, such, for instance, as papules of the skin or mucous patches of the mouth, or at the height of a characteristic secondary eruption a tubercular or gummatous tertiary lesion may develop. Irregular syphilis is a term applied to cases thus differing in course from those ordinarily observed.

It will be remembered that the diagnosis of syphilis can be made with absolute surety only when one or more of the constitutional symptoms develop. One of the first of these symptoms, and the one upon which diagnosis is usually founded, is enlargement of lymphatic glands at a distance from the chancre. Unless treatment be started at once, there will usually develop in a few days following this enlargement the secondary symptoms already mentioned,—namely, fever, osteocopic pains, skin eruptions, mucous patches, sore throat, falling of the hair in patches, and at times iritis, orchitis, or jaundice.

Alteration in the Blood.—If systematic observations of the blood be made, there will be found a diminution in the hæmoglobin percentage and red corpuscles, with slight leucocytosis. These blood changes are the *first* sign of constitutional syphilis, preceding lymphatic enlargement by two or three weeks; they become more marked with the advent of fever and on the appearance of the eruption. The Justin test (hæmoglobin reduction after mercurial inunction) is without diagnostic value (Necker, Huger, Christian).

Enlargement of Lymphatic Glands not anatomically connected with the Chancre.—The indolent enlargement which probably involves to some extent all the lymphatic glands of the economy, and which becomes apparent to the touch in certain accessible regions about the sixth week from the appearance of the chancre, must not be confounded with the syphilitic buboes which develop in the group of glands anatomically nearest to the chancre in about a week from the appearance of this lesion. This late glandular enlargement when characteristically developed is pathognomonic of syphilis. Though it is probable that all the lymphatic glands are involved, those in the post-cervical regions and the one lying in front of the internal condyle of the humerus, the epitrochlear gland, are most prone to exhibit the indolent cartilaginous, painless, non-inflammatory enlargement so characteristic of developing secondary syphilis. The submaxillary, the anterior cervical group, the axillary, in fact, all the superficial glands, may show the specific induration, but rarely in so characteristic a manner as those in the two regions named. The tumors formed vary in size from that of a pea to that of a chestnut.

The post-cervical chain passing downward from the occipital bone along the outer edge of the trapezius muscle is, in cleanly people at least, rarely enlarged from causes other than syphilis; thus painless, hard, indolent infiltration of these glands would be far stronger evidence of specific disease than a similar condition noted in the submaxillary and anterior cervical group, which, owing to the presence of catarrhal and inflammatory affections of the throat from which they receive lymph, are found enlarged in perhaps the majority of people. For a similar reason characteristically enlarged epitrochlear glands—that is, those above and in front of the internal condyle—constitute presumptive evidence of syphilis.

In syphilitic lymphatic glands the follicles of the delicate reticulated tissues are hypertrophied, and give rise to small lobulated projections upon the surface when the capsule is removed. The lymph-spaces exhibit a cellular infiltration, and the fibrous tissues separating the alveoli are thickened. Frequently these glands remain more or less hypertrophied not only during the period of secondary lesions, but also long after the syphilides have disappeared.

Although there is no clearly established relation between the extent of glandular lesion and the severity of other secondary symptoms of syphilis, early and well-marked glandular involvement frequently has been noted in attacks of more than usual severity.

Syphilitic Fever.—About the time of glandular enlargement, and coincident with the earliest eruption, or preceding it, fever develops, associated with pallor, weakness, general malaise, headache, coated tongue, anorexia, and muscular or arthritic pains. The temperature rarely rises above 102° F., and the pulse is not markedly affected. In many patients the fever is either absent or so slightly marked that it is not noticed. It rarely becomes so severe as to oblige the patient to keep to his bed. Exceptionally it assumes a malarial type, being characterized by irregular paroxysms of chills, fever, and sweat, but differs from malaria in the irregularity of the paroxysms and in the fact that quinine is utterly without effect in controlling it, while mercury is curative.

When the fever is continued and moderate in severity, and associated with depression of spirits, pallor, headache, and general debility, it may strongly suggest typhoid. If continued and of high grade, running to 104° or 105° F. and associated with evident osteocopic pains, it may lead to a suspicion of developing eruptive fever. If associated with an outbreak of pustular syphiloderm, such as exceptionally appears as an early skin lesion, the diagnosis from smallpox may be exceedingly difficult.

The involvement of the joints in early syphilis may, if associated with syphilitic fever, make the diagnosis of the latter from rheumatic fever a matter of impossibility till other symptoms of syphilis develop.

Diagnosis.—In making a diagnosis of syphilitic fever, the history of a preceding chancre and the presence of general lymphatic enlargements are, of course, matters of prime importance. In addition to the history, it is to be noted that syphilitic fever is frequently associated with a clean tongue, good digestion, normal condition of the bowels, and an absence of the special diagnostic features which characterize each of the fevers with which it may be confounded, as, for instance, the plasmodia and enlarged spleen of malaria, the tympany and spots of typhoid, the crisis of variola, the drenching sweats and acid urine of rheumatism.

It commonly subsides shortly after the appearance of the eruption. When it is continuous in type, is pronounced, and lasts for some time, the probability is that the attack of syphilis will be unusually severe and prolonged. In exceptional cases it does not appear till after the eruption has developed. It is mostly in women that the severe forms of continuous syphilitic fever are observed.

Syphilitic Neuralgia.—Coincidently with the syphilitic fever and constituting one of its symptoms, but also developing in the absence of evident fever, or sometimes preceding it, there may be dull pain, which is commonly neuralgic and shifting in character, and is felt mostly about the back of the neck, the back, and the shoulders, though it may be localized in any portion of the fibro-osseous system. This pain is most apt to be noticed at night; when continuous and severe there are usually nocturnal exacerbations. It occasionally attacks one or more joints, and may be accompanied by effusion and fixation; or it may assume a distinctly neuralgic type, simulating pleurodynia or other form of localized pain. Headaches, with nocturnal exacerbations, and sometimes associated with vertigo and nausea, point to meningeal congestion.

Frequently the pains are osteocopic (bone-breaking) in character, and are accompanied by marked tenderness over certain bones, particularly the middle third of the ribs and the lower third of the sternum. This is so often noted that some diagnostic value is given to the presence of pain on moderate pressure over these bones. These osteocopic pains are explained (Jullien) on the ground that the medulla of the bone takes part in the general lymphatic enlargement, thus occasioning pressure upon the nerves. Painful nodular swellings over the frontal and parietal bones, or over the long bones, are also noted at times.

In doubtful cases rheumatoid, neuralgic, and osteocopic pains, either singly or associated, are of great value in deciding for or against the presence of syphilis. In some instances lymphatic enlargement and syphilitic pains may be the only symptoms which develop, fever being absent.

Among the symptoms which exceptionally precede alopecia and the secondary eruption, jaundice, albuminuria, ravenous appetite or bulimia, alteration in the sensibility of the skin, exaggerated reflexes, and enlargement of the spleen have been observed.

Syphilitic Eruptions of the Skin and the Mucous Membranes.—The *syphilides*, or eruptions of the skin, commonly appear a few days after the general glandular enlargement, though they are occasionally the first manifestations of constitutional disease. They are usually found about the forty-second day after the chancre. Exceptionally they have been seen within two weeks. On the other hand, they may not develop for four or five months, or in some few cases secondary syphilis may never appear, tertiary lesions first proving conclusively that a genital sore was a chancre. This is especially liable to be the case if mercury has been given before the appearance of secondary symptoms.

Cutaneous and mucous syphilides are more superficial in the early stages of the constitutional disease; as it grows older these lesions become deeper.

Thus the syphilides of the first period of secondary syphilis are due to a local hyperæmia and slight cell-infiltrate, affecting only the epidermic and papillary layers of the skin and producing erythematous, macular, and papular lesions. These heal without leaving scars. The older syphilides belonging to the late secondary and the tertiary period not only affect the epiderm and the papillary layer, but involve also the true derm and even the subdermic tissues, appearing as pustules and tubercles, which are often destructive and are followed by cicatrices. These lesions are due to a cell-infiltrate much like that of granulation-tissue, except that it is not nearly so vascular.

The syphilides may, so far as the lesions are concerned, mimic with absolute fidelity many of the well-known skin diseases; there are, however, certain characteristics of the eruption, taken as a whole, which will generally make a correct diagnosis possible.

The general features of secondary syphilitic eruptions are as follows:

1. The lesions develop slowly, are painless, and do not itch.
2. They are rounded in form and grouping, and tend to scale.
3. They are of a copper or raw-ham color.
4. They are symmetrical.
5. They are polymorphous.
6. They are superficial.
7. They yield to mercurial treatment.

The later eruptions of the secondary period—that is, those occurring after the first year—and those of the intermediary and tertiary periods exhibit the following characteristics:

1. They are rounded in form and circinate in grouping. This is particularly well marked.
2. The lesions do not appear as a general eruption, but are grouped upon certain regions of the body.
3. They are deep, often involving the whole thickness of the skin and the subcutaneous tissue.
4. If dry, they are covered with a thin layer of gray, slightly adherent scales.
5. If ulcerating, they form punched-out, chronic ulcers, often covered with raised, thick, greenish-black, adherent crusts.
6. They are accompanied by very slight subjective symptoms.

When a general eruption first appearing on the chest and abdomen presents these features after full development, it can certainly be judged syphilitic in its nature. Frequently, however, the syphilide will depart in one or more points from the type to which it should theoretically correspond.

The *absence of subjective symptoms*—that is, freedom from pain and from itching—is a rule which has but few exceptions, if eruptions on the scalp and the hairy parts of the body are excluded. In these regions itching is very common. On the body and extremities the eruption is often not noted by the patient till the physician calls attention to it; or the patient becomes aware of it only because he has noticed it while dressing or bathing.

Exceptionally the itching is severe and harassing; this may arise from the specific eruption, but commonly it is found to be dependent upon an intercurrent condition, such as urticaria or prurigo or the presence of pediculi.

The rounded form and grouping of the syphilides are usually fairly well marked, though individual lesions widely depart from this type. The circinate grouping is much more pronounced in the late secondary and in the tertiary lesions; indeed, it is a striking feature of the eruption. In the early secondary lesions, particularly in roseola, this grouping is rarely so conspicuous as to be noticeable till it is carefully searched for.

The *raw-ham or copper color* of the eruption is not pronounced at first. The early erythema is usually a dusky red, though it may present the rosy-red hue of simple erythema. As the lesions develop, a certain amount of skin pigmentation takes place, the erythematous patches no longer disappearing entirely on pressure, but leaving a dark stain. The macules and papules become still more dusky, like raw ham, or even present a distinct coppery hue. This is fairly constant, but is not characteristic till the lesion has persisted at least some days. A similar coloration, together with absence of itching, is sometimes observed in the skin eruptions of gouty and rheumatic subjects. This pigmentation may last for years; usually it disappears in a few months. The epidermic layer of the skin suffers by reason of the interference with its nutrition caused by the cell-exudation in the papillary layer beneath it. Most syphilides, therefore, tend to become squamous.

The *symmetrical development* of the secondary syphilides is an almost constant feature of the eruption. The two corresponding sides of the body are usually invaded equally and by a somewhat similar form of the eruption. This tendency to symmetrical development is not observable in tertiary eruptions.

The *polymorphism* of secondary syphilides is at times the feature of most importance in establishing a correct diagnosis. This term implies that the lesion is many-formed; that is, while in one part of the body it is macular, in another it is papular, in still another pustular, etc. The skin diseases which syphilis simulates usually conform to one type; that is, if certain lesions are observed in one part of the body, similar lesions, and no others, will be observed in other parts. This is not the case with syphilis, except at the beginning.

Usually the eruption develops gradually, first in the form of an erythema so slight as not to be noticed till the patient's skin is exposed to the air, when the eruption appears on the anterior and lateral aspects of the chest and belly as an exaggeration of that mottling which constantly occurs when a portion of the surface generally covered is suddenly chilled. This erythema becomes quite distinct in a few days. It persists and gradually shows the pigmentary changes; but in the mean time papules are developing in certain regions, or perhaps pustules or vesicles. The multiform eruption is due to the fact that the lesions persist, one variety not completing its course before another is developed.

The general eruption receives its name from the predominant lesion.

The *superficial* character of the early syphilides is due to the tendency of bacterial growth to occur in regions where the blood-current is slowed. The most marked effects of the disease in this early secondary stage are, therefore, shown in the papillary layer of the skin, the epidermis becoming secondarily involved.

The Influence of Mercurial Treatment.—Although individual lesions may persist for months in spite of most careful medication, the usual effect of efficient mercurial treatment upon general secondary syphilitic eruptions is prompt and pronounced. Within a week the eruption is undergoing rapid resolution. This gives a means of diagnosis which in doubtful cases is exceedingly valuable.

ERUPTIONS OF THE MUCOUS MEMBRANES.—Involvement of the mucous membrane of the mouth is one of the most constant symptoms of constitutional syphilis. It often occurs even before the skin eruptions.

It may appear in the form of an *acute erythema* (acute syphilitic angina), involving the palate, half-arches, tonsils, and pharynx, accompanied by a marked œdema, closely resembling the non-specific sore throat, and generally ascribed to catching cold; more commonly it appears in the form of *mucous patches.* Indeed, these are the most constant lesions of secondary syphilis. They are commonly found on the tongue, the buccal mucous membrane, the half-arches, the tonsils, and the palate. Exceptionally they extend from the posterior half-arch to the pharyngeal mucous membrane. They appear as gray-white, irregularly shaped markings, not elevated above the surrounding healthy surface. The appearance presented by an individual lesion is very like that produced by brushing the mucous membrane with a stick of silver nitrate, except that the margins of the mucous patch are more sharply defined.

Together with the mucous patches there are often erosions and fissures of the tongue. The latter when deep and placed at the sides of the organ are painful, though the mouth eruption of secondary syphilis conforms to the general character of the disease in presenting few subjective symptoms. Contact with irritating or very hot foods may, however, cause pain.

Both the mucous patch and acute erythema also develop in the urethra of the male, giving rise to a discharge which may simulate a mild attack of gonorrhœa. In the female there may be acute erythema of the vagina; more commonly, indeed, in the majority of cases, mucous patches develop about the vaginal outlet.

SYPHILITIC ALOPECIA.—The impaired nutrition of the hair-follicles incident to constitutional syphilis causes the hair to lose its lustre and to come out in irregular patches. Usually the scalp and the eyebrows are alone affected. Sometimes all the hairy regions are involved, and there results complete denudation of the entire body.

The rapid onset of the baldness, the irregularity of distribution, and the fact that under constitutional treatment it is completely curable are characteristic features of the condition.

At times alopecia attacks the eyebrows alone, causing an irregular bald patch. This is so peculiar to syphilis that it is considered diagnostic. (Fournier.)

The alopecia which comes on later in the disease as a consequence of ulcerative lesions is due to atrophy of the hair-follicles, and is incurable.

SYPHILITIC ONYCHIA is dependent upon impaired nutrition of the nail matrix, and is commonly associated with the papular or pustular eruptions. The nails may become brittle and lustreless, or may be hypertrophied and deformed, or may exfoliate. These processes are associated at times with deep ulceration around the nails (perionychia).

Syphilitic Involvement of the Viscera.—At about the time the early constitutional symptoms, such as general lymphatic enlargement, fever, and syphilodermata, develop, there may be manifestations of the disturbing effect of the virus upon the viscera, though such signs, at least in their more serious forms, do not usually occur till late in the disease. The visceral symptoms which develop in early secondary syphilis are nearly always dependent upon an acute hyperæmia which, though caused by the syphilitic poison, differs in no way from similar conditions brought about by other causes, except in the fact that it yields promptly to specific treatment. Thus there may be temporary albuminuria from hyperæmia or inflammation of the kidney, violent cephalalgia from meningitis, pleural effusion from pleuritis.

In the early stage of secondary syphilis the liver may be hypertrophied. This may be accompanied either by pain or by jaundice, or by both of these symptoms. Jaundice does not appear as an isolated symptom of syphilis. Syphilides of the skin or of the mucous membrane are found associated with it.

It is more convenient to consider under tertiary syphilis the effects of the disease on the muscles, the bones, the nervous and vascular systems, and the viscera, since the secondary manifestations of the disease in these portions of the body are transitory and comparatively rare, and present only the ordinary symptoms of a more or less acute inflammation.

It is noteworthy that the symptoms in connection with the viscera become less acute in type as the attack of syphilis becomes older, and that when they develop they resemble the chronic rather than the acute form of inflammation, until finally in the tertiary period the formation of gummata takes place.

Syphilitic Disturbances of the Nervous System.—The commonest symptom of involvement of the nervous system in constitutional syphilis is the *syphilitic neuralgia* to which reference has already been made. This and the other symptoms may be dependent upon the general cachexia, or more rarely may be due to pressure, as from enlarged lymphatics or swelling of the medulla or the periosteum of bones. The first and second branches of the trifacial nerve are especially subject to this form of syphilitic neuralgia.

Cephalalgia is common in the early secondary period. It is usually of moderate severity, is not a surface pain, but is located in the frontal or the occipital region of the brain, and is harassing rather than disabling; there are nocturnal exacerbations. Very exceptionally it becomes exceedingly severe.

Analgesia when present is found over the metacarpal region of each hand. It is an early, usually symmetrical lesion, and is not accompanied by anæsthesia, tactile sensation being retained. It may exceptionally take the form of thermo-analgesia or muscular analgesia.

Paralysis, particularly of the muscles of the eye and the face, is occasionally observed in early syphilis. It may involve single muscles or muscle groups, or may cause hemiplegia or paraplegia.

The nerve manifestations of secondary syphilis are usually short-lived and yield quickly to constitutional treatment.

Syphilitic involvement of the bones, joints, and tendinous sheaths is not rare in the secondary stage of the disease. The bones lying nearest the surface exhibit painful nodular swellings with the characteristic symptoms of acute periostitis. One or many joints may be the seat of more or less acute inflammation. Certain of the tendinous sheaths may develop the crackling and tenderness of tenosynovitis.

IRITIS is the commonest eye manifestation of secondary syphilis; it may assume the plastic or the serous form. In either case the symptoms are like those of the inflammatory form of the disease, except that they are less acute.

EPIDIDYMITIS occasionally develops as a lesion of early constitutional disease; it is unilateral, painless, and quickly subsides on treatment. Orchitis is rarely observed till the tertiary stage.

As a result of secondary syphilis, menstrual disturbances are very common: these may take any of the forms noted in debility from other causes. Both amenorrhœa and metrorrhagia have been observed. In the pregnant uterus abortion generally occurs.

SYPHILITIC SKIN ERUPTIONS.

It should be remembered that recent syphilides (secondary) are superficial, while later eruptions (tertiary) are deep, but that typical tertiary eruptions may exceptionally appear in the secondary stage of the disease, or the secondary eruptions may appear late. The skin lesions of syphilis may be classed as follows:

1. Erythematous syphilides, called also erythema, macules, roseola.
2. Papular syphilides. In accordance with their size, shape, and surface, the papular syphilides are:
    - *A.* Conical or acuminated papular syphilides.
        - *a.* Large.
        - *b.* Small.
    - *B.* Flat or lenticular papular syphilides.
        - *a.* Large.
        - *b.* Small.
    - *C.* Moist papules (mucous patches).
    - *D.* Papulo-squamous syphilides.
3. Vesicular syphilides.
4. Pustular syphilides.
    - *a.* Small, acuminated pustular syphilides (miliary).
    - *b.* Large, acuminated pustular syphilides (acneiform).
    - *c.* Small, flat pustular syphilides (impetiginous).
    - *d.* Large, flat pustular syphilides (ecthymatous).
5. Pigmentary syphilides.
6. Bullous syphilides.
7. Tubercular syphilides.
8. Gummatous syphilides.

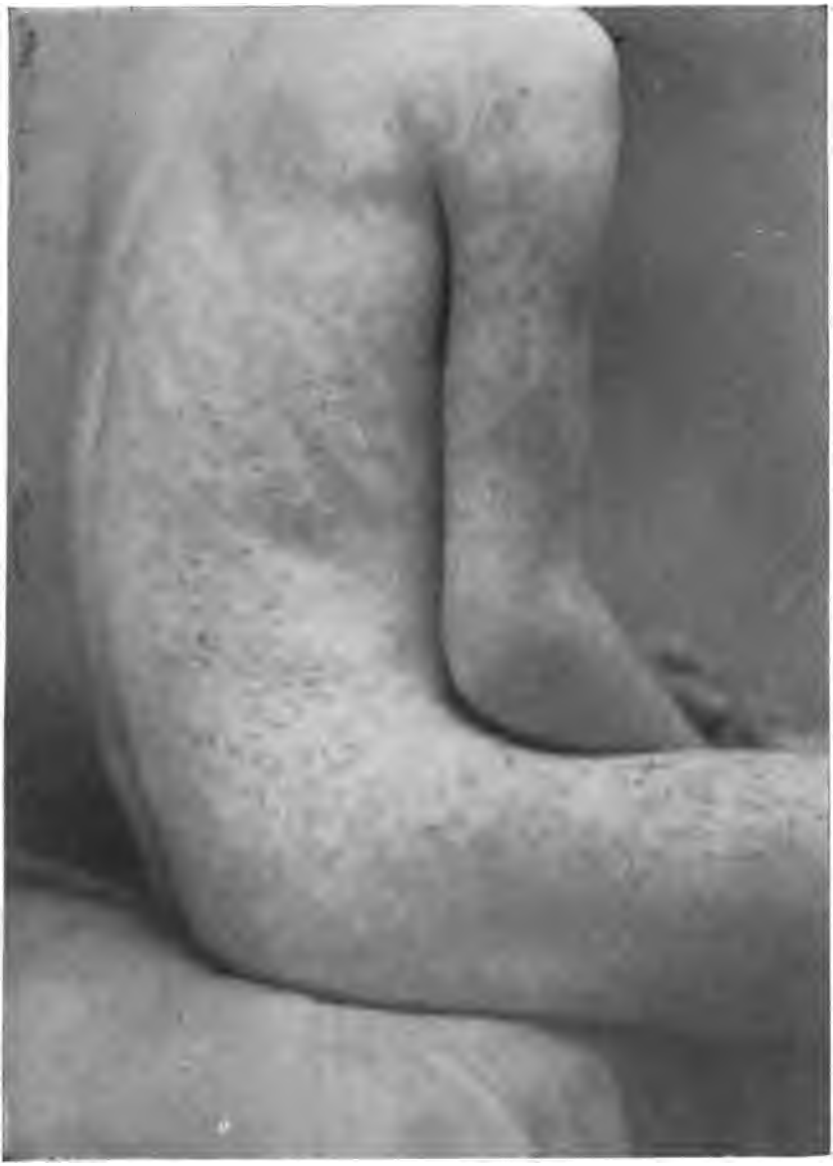
A pathological study of the secondary skin eruptions shows that they are made up of a small round-celled infiltration of the cutis and adnexa, together with the lower layers of the rete Malpighii. The blood-vessels are dilated, the endothelium is thickened, and there is a small-celled infiltrate of the adventitia. These changes involve the vessels of the papillæ, the Malpighian net-work, the hair-follicles, the sebaceous glands, and the sweat-glands. Whether the eruption be macular, papular, or pustular, the pathology is the same.

The pathology of the tertiary lesions differs from that of the secondary only in that the small-celled infiltrate is much more extensive, invading the entire thickness of the skin and the subcutaneous tissues. As a result, this mass of embryonal tissue, always poorly vascularized, degenerates centrally, and either ulcerates, discharging externally, or is partly absorbed and partly converted into fibrous tissue.

Grouping the skin lesions in accordance with the time of development, the eruptions of the secondary period are:

The erythematous syphilides (roseola); the papular and papulo-squamous syphilides (mucous patch, lichen, condyloma, psoriasis,

FIG. 264.



Erythematous syphilide.
(From the collection of photographs of Dr. George Henry Fox.)

etc.); the general pustular syphilides (acne, impetigo); the pigmentary syphilides; the bullous syphilides; the vesicular syphilides; the tubercular syphilides.

During the same time there may develop on the mucous membranes:

1. An acute erythema;
2. Mucous and scaly patches; or,
3. Superficial ulcerations.

With the exception of the pigmentary syphilide and the squamous form of the papular syphilide, these are general eruptions and appear during secondary syphilis in about the order given, the tubercular lesion being well on the border-line between the secondary and the tertiary period.

The syphilides of the tertiary stage are pustular and bullous syphilides, which appear discretely or in groups, and which ulcerate deeply (ecthyma, rupia), and gummata.

The mucous membrane manifestations of this stage are mucous and scaly patches and gummata.

Erythematous Syphilide.—This is the earliest and the most constant of all the skin lesions of syphilis. It appears about the same time that the general lymphatic enlargements become apparent. In the uncleanly and careless it may run its course without attracting the attention of the patient. The eruption exhibits less of the rounded shape or grouping than any of the other syphilides.

It first appears as an irregular rose-red mottling of the surface, such as is constantly seen when covered surfaces are exposed to the cold. The lesion may not develop beyond this point, terminating promptly under treatment, or at times even without it, in a slight branny epithelial shedding. More commonly syphilitic roseola develops,—that is, patches of varying size are formed, the smallest not larger than a pin-head, the largest the size of a quarter- or a half-dollar. (Fig. 264.) These patches are irregular in shape, frequently rounded or oval, but not necessarily so, and shortly become raw-ham or even coppery in color. At first pressure of the finger and emptying of the superficial vessels leave the skin white for a moment, but later there is distinct pigmentation, the copper color remaining.

The eruption commonly appears on the sides and front of the belly and chest. It is also frequently observed on the back and on the flexor surfaces of the extremities. It is sometimes seen at the hair-line of the forehead and upon the palmar and plantar surfaces. It may, of course, develop on any surface of the body, but the regions just given are, in their order, those of preference.

The full erythematous eruption develops in about a week. Under treatment it rapidly disappears, even the pigment being absorbed and leaving no trace. If not treated, it lasts for weeks or months, and is accompanied by papular and pustular lesions, giving the eruption one of its characteristic features,—polymorphism.

Diagnosis.—The diagnosis of the erythematous syphilide is much simplified by the presence of concomitant signs of the disease. At this stage the remains of a chancre are usually present, the enlarged glands can be felt, and a history of rheumatoid pains, of sore throat, of headache, and of a slight feverish attack will be given.

Simple erythema and the copaiba rash may both simulate syphilitic roseola. Simple erythema, however, is not associated with a history of chancre or with the signs of early secondary syphilis, is more commonly accompanied by distinct fever and digestive disorder, itches, and develops and subsides in a short time, showing no tendency to persist and to become pigmented.

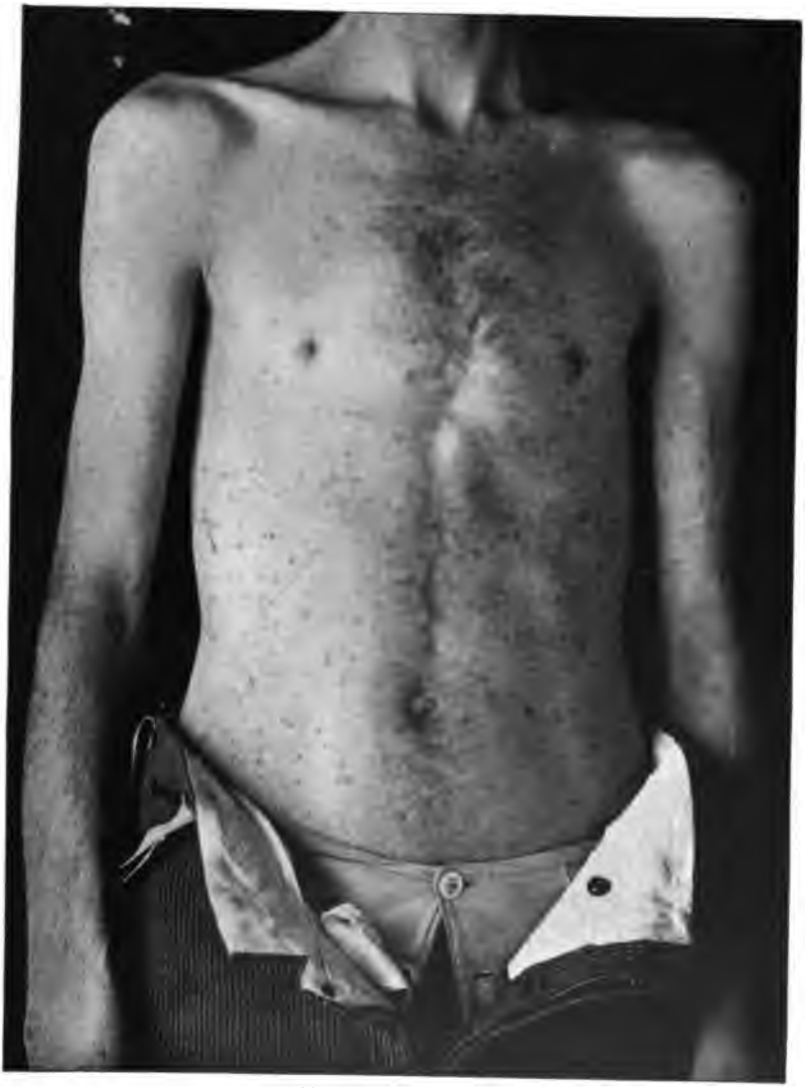
The copaiba rash often exhibits large itching confluent patches, which run their course in a few days, which appear with special intensity in certain regions, such as the extensor surfaces of the joints, and which subside promptly on stopping the drug. There is a history of ingestion of copaiba, or, if this is denied, an examination of the urine will demonstrate the copaiba odor.

Measles is characterized by a history of exposure to the disease, Koplik's spots, high fever, cough, an eruption beginning on the face and becoming universal rapidly, and the pinkish-red, blotchy appearance of the macules.

Papular Syphilide.—The lesions of the papular syphiloderms appear as hard, small or large, acuminated or flat, smooth or scaling, rounded elevations, exhibiting a characteristic raw-ham or copper color. These lesions are due to circumscribed hyperæmia, together with cellular infiltration of the papillary layer of the skin. They are frequently converted into vesicles or pustules.

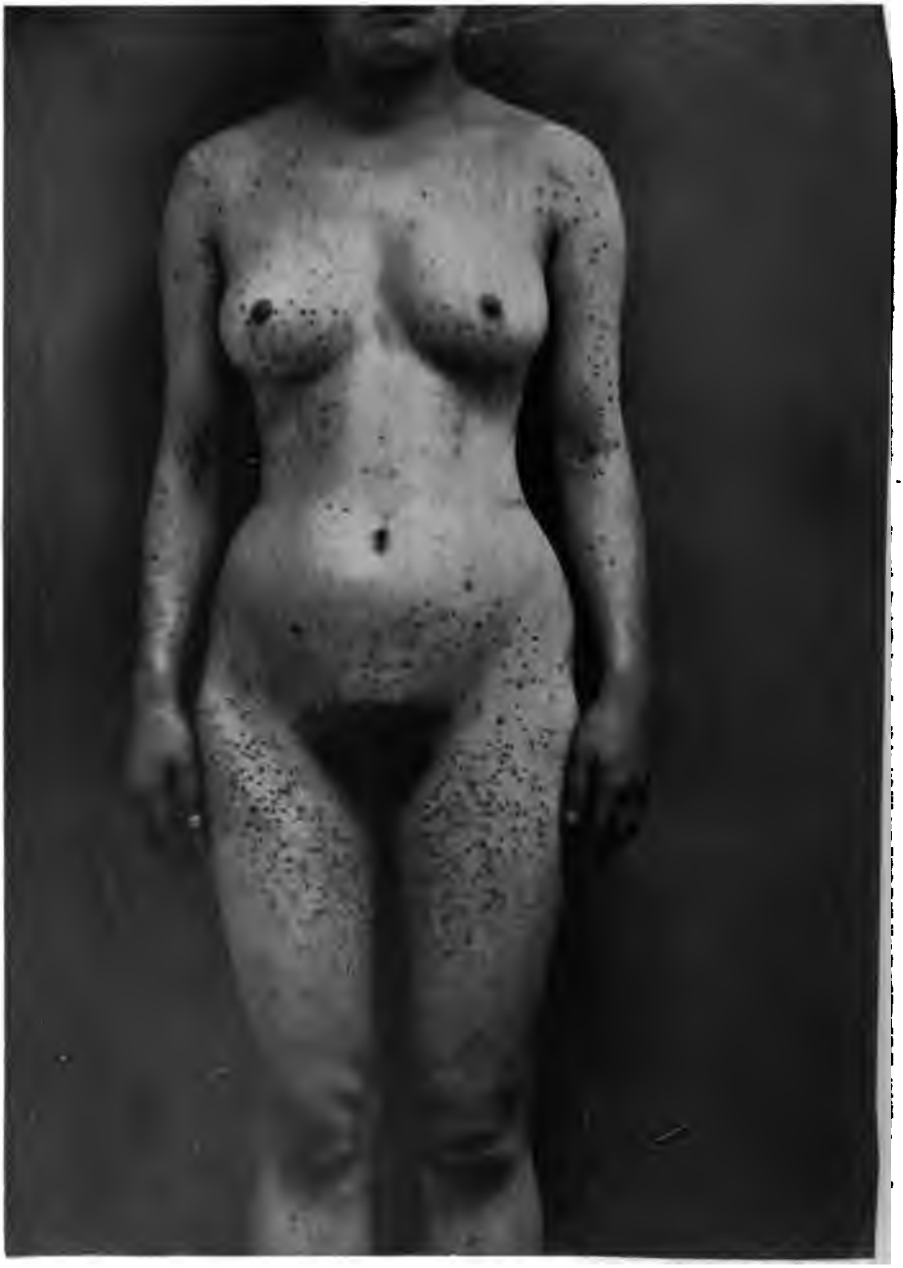
THE SMALL PAPULAR SYPHILIDE.—This eruption is usually an early manifestation of constitutional syphilis, exceptionally even preceding the roseola; frequently it does not develop till considerably after the fourth month. The papules may be conical, rounded, flat (lenticular), or umbilicated, and often exhibit a fine scaling. They vary in size from that of a pin-head to that of a split pea. At first rose-red, they become raw-ham or coppery in color. The lesions are apt to exhibit a circinate grouping, appearing as segments of circles, as complete circles, or in figures of eight. The eruption is usually well marked and involves a large surface. (Fig. 265.)

FIG. 265.



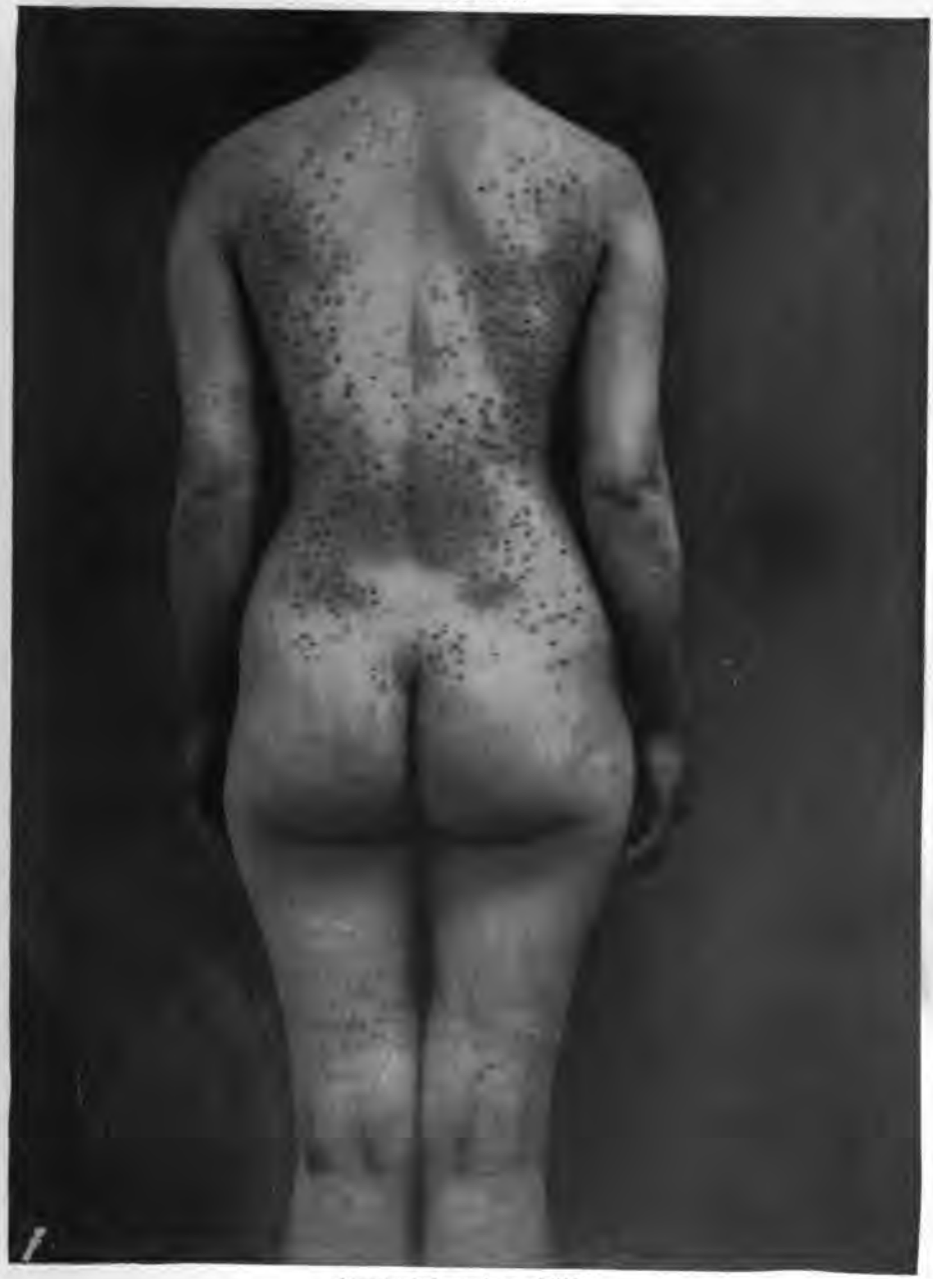
Flat papular syphilide.

FIG. 266.



Acuminated papular syphilide.
(From the collection of photographs of Dr. George Henry Fox.)

FIG. 267.



Acuminated papular syphilide.
(From the collection of photographs of Dr. George Henry Fox.)

FIG. 268.

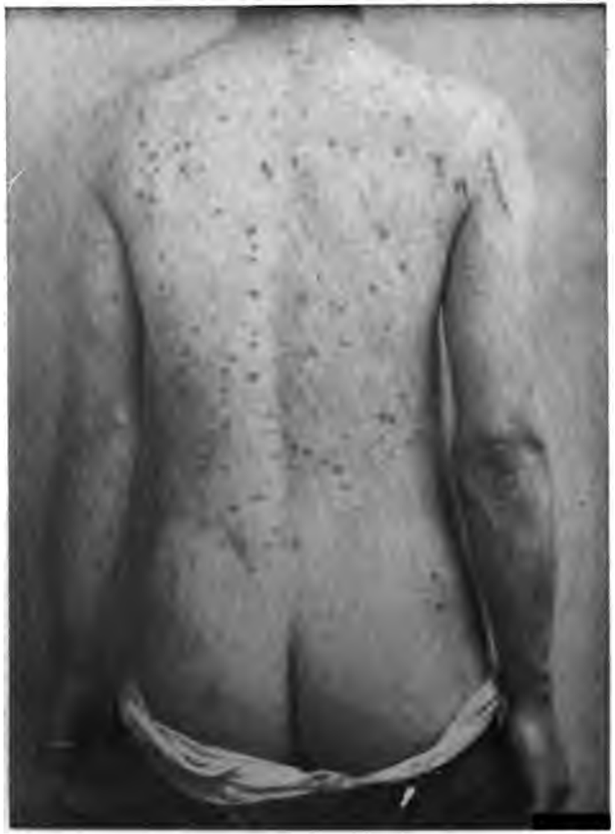
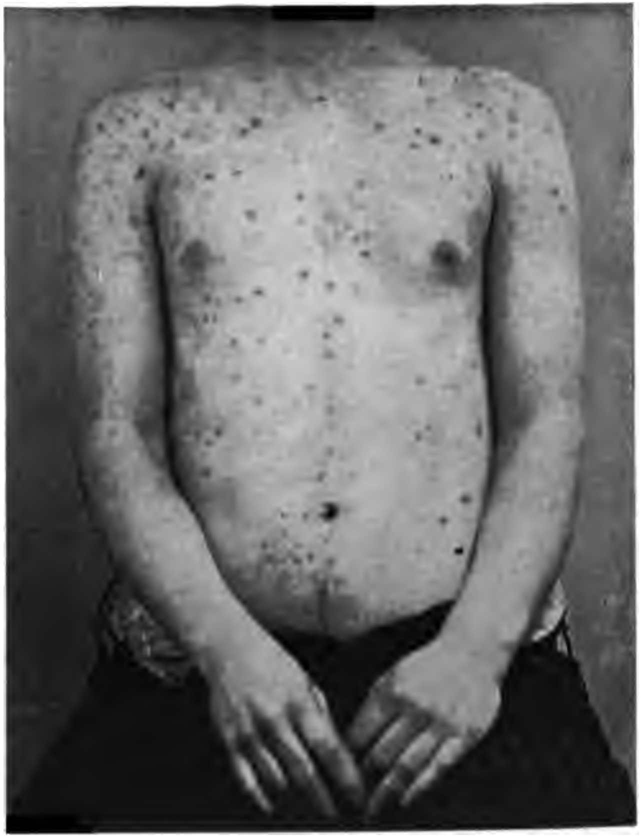
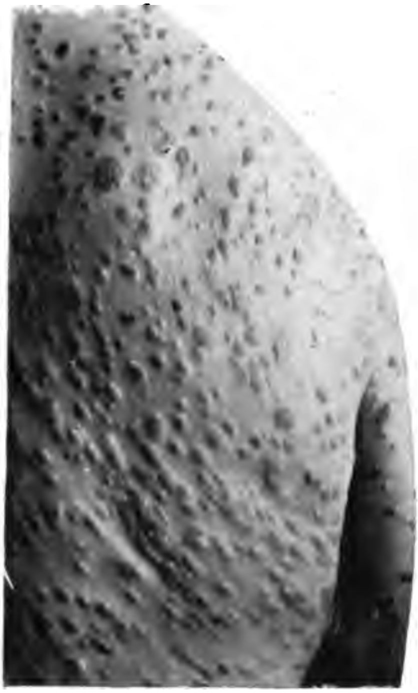


FIG. 269.



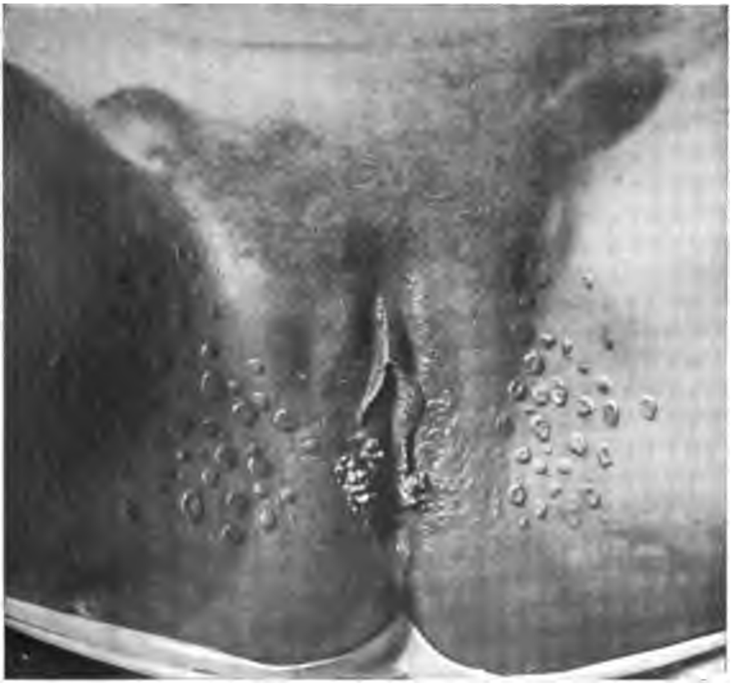
Large flat papular syphilide.
(From the collection of photographs of Dr. George Henry Fox.)

FIG. 270.



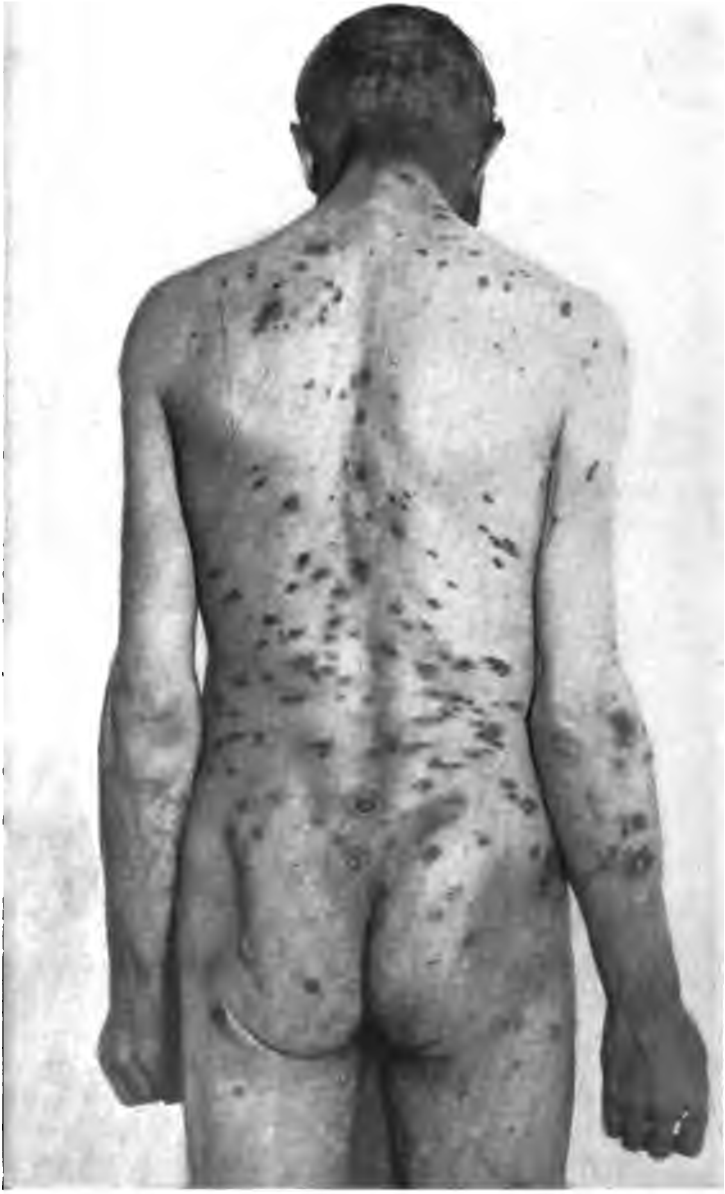
Large flat papular syphilide.

FIG. 271



Vegetations and mucous patches about the vulva.

FIG. 272.

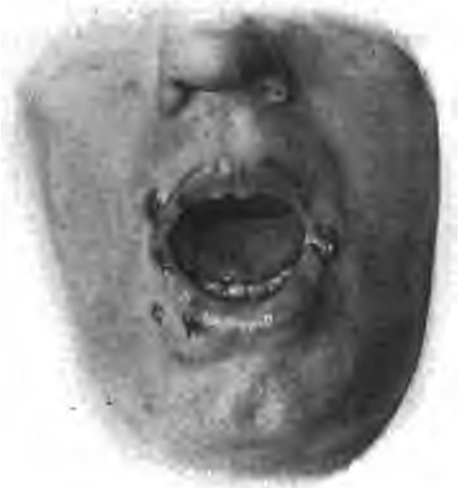


Large flat papular syphilide, showing scaling.

The acuminated (miliary) form is first noticed on the face. It subsequently appears on the trunk and the extremities.

The flat, lenticular, lichen-like form appears first about the shoulders, but the face, body, and extremities are soon involved, the lesions being particularly abundant about the flexures of the joints. The palmar and plantar surfaces also suffer. The eruption is somewhat chronic in its course, and is more resistant to treatment than the erythema. It yields in three or four weeks, but is subject to relapses.

FIG. 273.

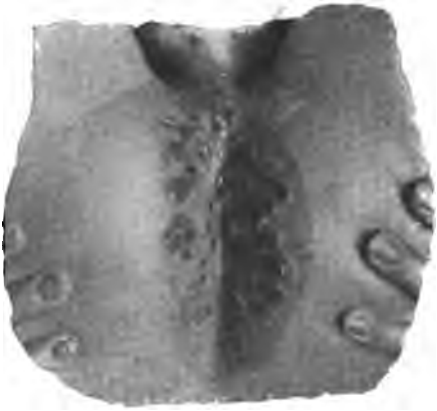


Mucous patches of the lips.

THE LARGE PAPULAR SYPHILIDE.—As in the smaller lesions, these papules may be conical or flat.

The large conical papules are usually discrete, few in number, are found associated with the small papules, and are most abundant on the back, the buttocks, the back of the neck, the face, and the extensor surface of the thighs. (Figs. 266, 267.)

FIG. 274.

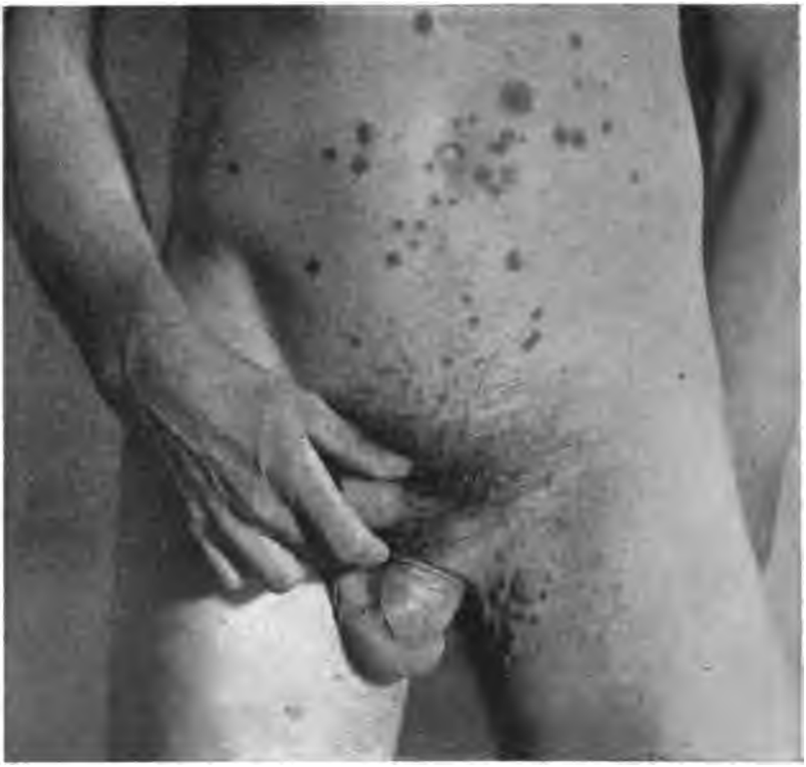


Mucous patches about the anus.

The large, flat papules vary in size from that of a shirt-button to that of a penny. (Figs. 268, 269, 270.) They are sharply circumscribed, elevated, and commonly exhibit a branny scaling. The eruption may be widely distributed or may be grouped in certain regions. Thus, the lesions are frequently found on the back, the nape of the neck, the forehead, the flexor surfaces of the extremities, and the scrotum, and about the mucous outlets. (Fig. 272.) Sometimes the lesions become fissured, and may give rise to severe pain. This is especially apt to occur on the hands and feet and about the mouth and the anus.

Mucous Patch.—When the papular syphilide develops on surfaces of the body which are kept constantly moist by secretions, or which are subject to moisture and friction, as on mucous surfaces at the angles of the mouth (Fig. 273), beneath the dependent mammary gland, about the anus (Fig. 274) and the vulva (Fig. 271), within the foreskin, on the scrotum, or between the toes, instead of the branny scaling which characterizes the dry lesion there is often an abraded surface, which secretes freely and is partly or completely covered by a gray, adherent, offensive pseudo-membrane. The irritating secretions of these mucous patches frequently give rise to warty growths in the immediate environment. Sometimes the moist papule exhibits, in addition to hyperæmia, cell infiltration and abrasion, or superficial ulceration, a distinct papillary overgrowth, forming small or large papillomata. (Fig. 275.) These are properly termed condylomata,

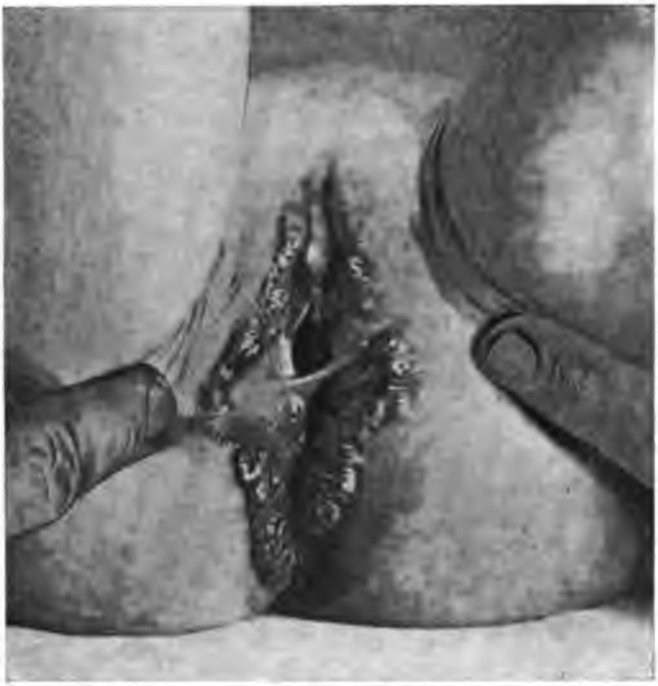
FIG. 275.



Papular syphilide, showing papillary overgrowth.

and should be distinguished from the mucous patch in which hypertrophy of the papillæ either is not present or is not marked. Commonly these condylomata appear as raised flat, raw surfaces, the cellular infiltration being so abundant that the papillary nature of the growth is but imperfectly marked. Occasionally large cauliflower-like warty growths are formed, particularly in the regions of the face, scalp, shoulders, and genitals (Duhring). These are termed vegetating papules, and are often accompanied by abrasions and crusting of the surrounding skin. (Fig. 276.)

FIG. 276.



Syphilitic vegetations.

When subject to friction and not treated, the mucous patches may form ulcers. On the delicate skin of babies mucous patches frequently develop, and are in them one of the commonest lesions of syphilis. In the adult they appear early, but are prone to relapses, and may occur in the mouth even during the tertiary stage of syphilis. The secretions of the mucous patch are highly contagious.

Diagnosis of the Papular Syphilides.—The concomitant signs of syphilis, such as the remains of a chancre, enlarged lymphatic glands, sore throat, alopecia, scabs in the hair, etc., are usually present, and, in conjunction with the copper color of the eruption, its polymorphism, the absence of itching, and its grouping about the back, the neck, the forehead, the sides, and the buttocks, render the diagnosis of this syphilide easy.

When the large, flat, papular syphilides develop, either in the dry form or as mucous patches, the diagnosis can be made with certainty, since these lesions are absolutely characteristic of syphilis and are simulated by no skin disease.

Acne papulosum and lichen are both closely simulated by some forms of the papular syphilides.

Acne papulosum is associated with none of the concomitant signs of syphilis, is found commonly about the forehead, cheeks, chin, shoulders, and back, leaves no pigmentation at the seat of cured lesions, and is often accompanied by pustules; or there may be scars resulting from the healing of the latter. When papular acne develops only on the forehead, the diagnosis must be formed mainly on the absence of other signs of syphilis.

Lichen may be acuminated or flat, and may be widely distributed. The lesions of this disease are dusky in color and occasion pigmentation of the skin. The individual papules are, however, angular in outline rather than rounded, and in place of a circular grouping are often arranged in rows or lines. They usually itch, and are not associated with any of the signs of syphilis. The eruption, however diffuse it may be, is papular throughout.

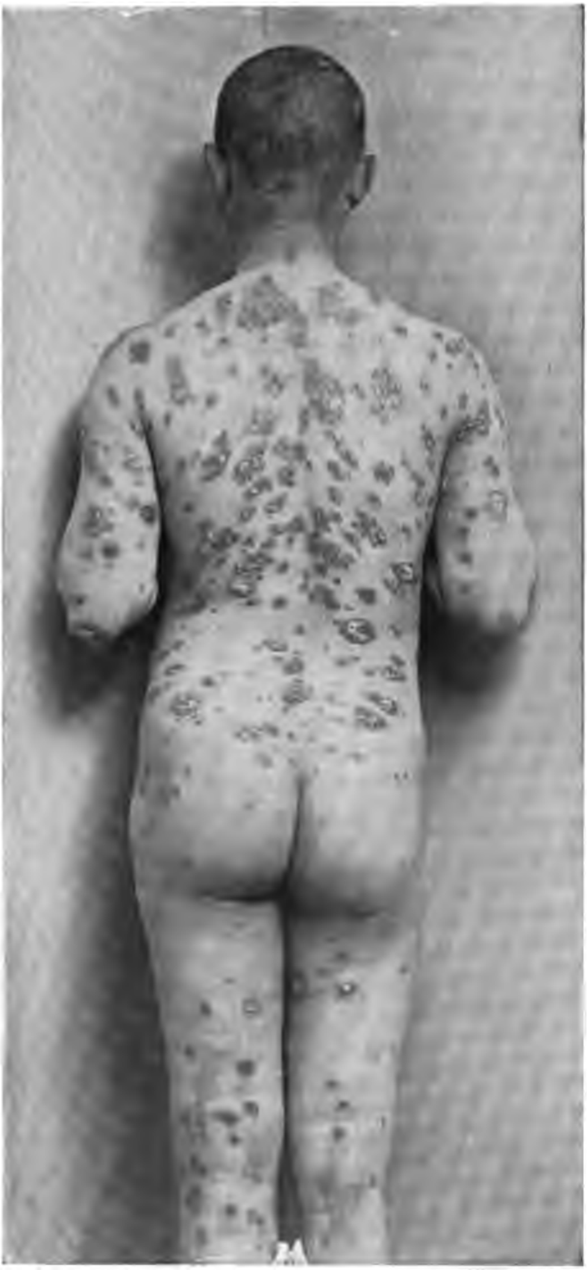
Keratosis pilaris, the conical elevations seated about the apertures of the hair-follicles and mostly found on the extensor surfaces of the thighs and arms and on the forearms, is sometimes mistaken for the small miliary syphilide. The absence of circular grouping, the distribution of the lesion, the uniform appearance presented by it, and the fact that each papule is invariably placed at the aperture of a hair-follicle, will, in the absence of other signs of syphilis, render diagnosis easy.

Prognosis.—Papular syphilides yield to treatment, leaving a brownish pigmentation, which ultimately disappears. The effect of mercury is not so immediate as in the case of roseola. Still, in a few weeks a general papular eruption usually fades completely under constitutional treatment. The recurrent forms are somewhat more obstinate. These are prone to appear in circinate groups.

Treatment.—Mercury should always be given, in some cases preferably by fumigation or inunction.

Papulo-Squamous Syphilides.—There is more or less desquamation with all the papular syphilides, but in some cases this may be so

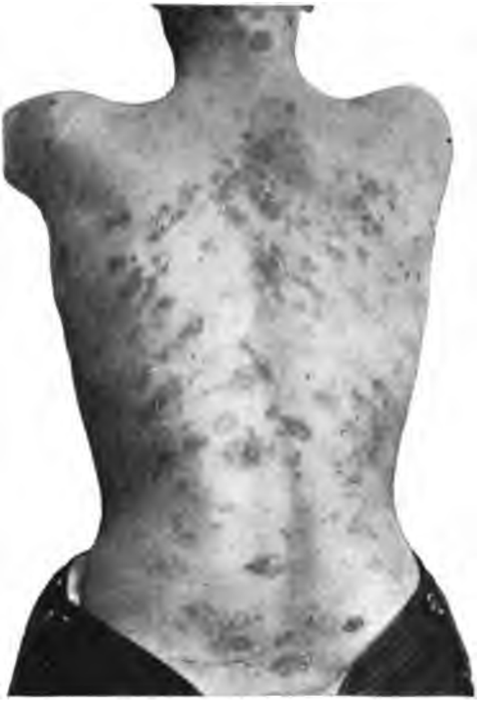
FIG. 277.



Papulo-squamous syphilide.
(From the collection of photographs of Dr. George Henry Fox.)

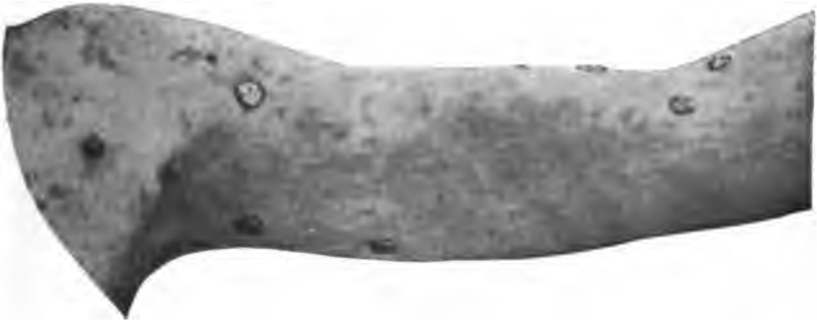
marked as to give the disease a distinctly squamous type. The lesions in this form of syphiloderm are generally flat, and are covered with fine gray scales, which are not very tightly adherent. As these scales are brushed away, the coppery glistening surface of the papule is exposed, surrounded with a fairly well-marked collar of ragged epithelium.

Fig. 278.



Papulo-squamous syphilide.

Fig. 279.



Papulo-squamous syphilide.
(From the collection of photographs of Dr. George Henry Fox.)

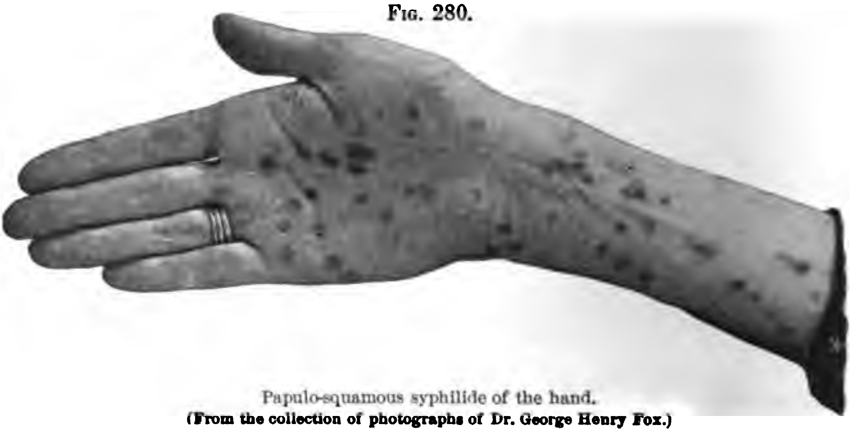
These lesions when they appear early may be multiple and general, the patches varying in size as do those of papular syphilis. (Figs. 277, 278.)

In recurrent, late eruptions the lesions may be few and grouped. (Fig. 279.) They may remain weeks or months without increasing in size, and commonly exhibit a distinct circinate arrangement of the individual papules of a group.

The well-marked papulo-squamous syphilides usually appear after the sixth month, and may develop in any subsequent period of the disease. The distribution of this lesion is similar to that of the papular syphilide.

On the palms and soles these papulo-squamous eruptions are most frequent and most resistant. (Figs. 280, 281, 282, 283.) In the early period of the disease they are symmetrical; later this feature is not noted. Instead of the familiar macule with glistening coppery centre and gray epithelial scales about the edges there may be a marked overgrowth of the corneous layer of the skin, forming hard conical projections in size from that of a pin-head to that of a pea. These can be dug out from the skin, leaving deep pits or depressions. They are most frequently noted on the soles, and are liable to occasion pain on walking. The papulo-squamous syphilides of the palms and soles are often complicated by painful and obstinate fissures.

FIG. 280.

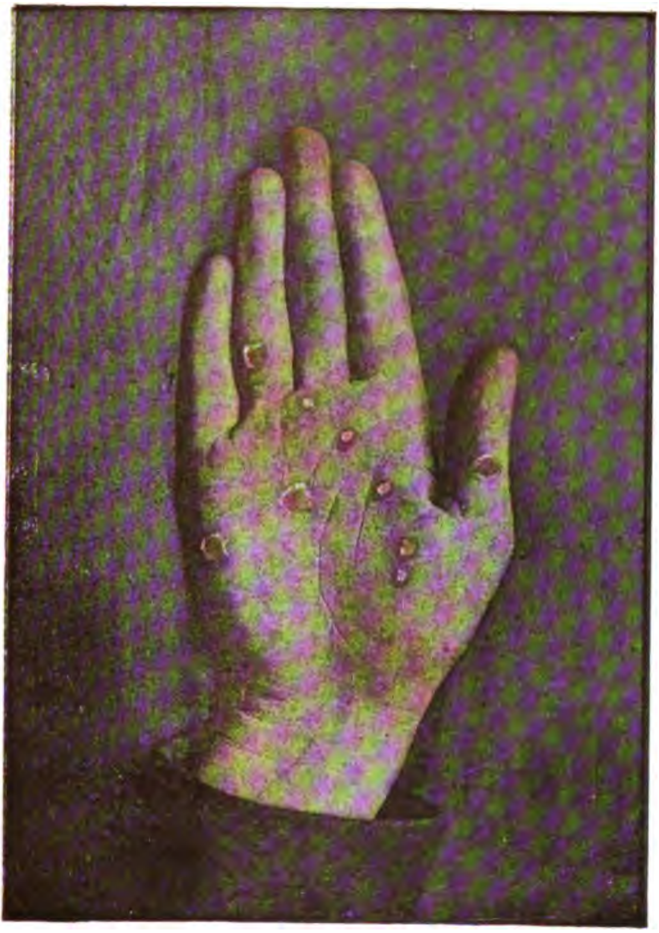


Papulo-squamous syphilide of the hand.
(From the collection of photographs of Dr. George Henry Fox.)

These lesions may appear in the third month, or much later. They are prone to relapse, beginning about the centre of the palm and extending peripherally, forming lesions of circinate or serpiginous shape.

Papulo-squamous eruption of the palms or soles alone, accom-

FIG. 281.



Papulo-squamous syphilide of the hand. (Fox.)

Fig. 282.

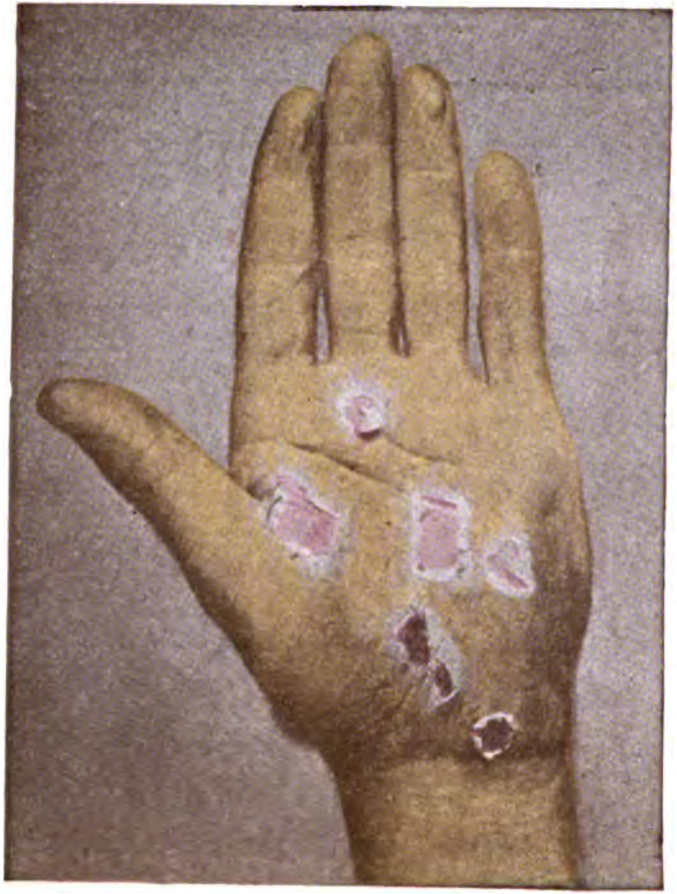
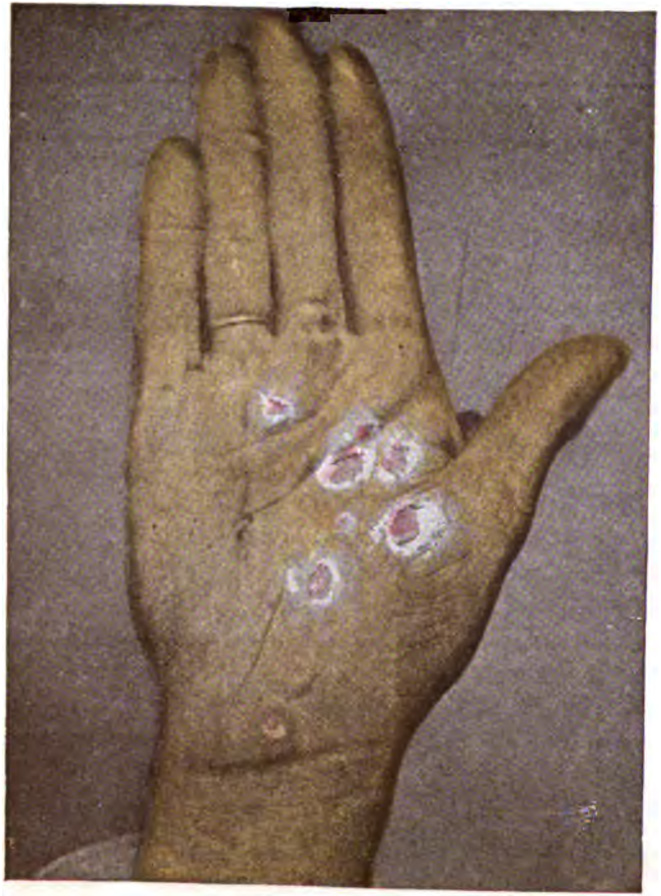


Fig. 283.



Papulo-squamous syphilide of the palm. (Fox.)

panied by but slight subjective symptoms, is almost pathognomonic of syphilis. Exceptionally the palmar syphilide appears as a diffuse exfoliation of fine epithelial scales, giving the surface a silvery aspect.

Diagnosis.—Papulo-squamous syphilides must be distinguished from psoriasis and from palmar eczema.

Psoriasis is entirely superficial, exhibiting but slight thickening, is not polymorphous, frequently appears before the twentieth year, its individual lesions are not markedly raised above the level of the surrounding surface, it is covered with a thick, imbricated skin, made up of white scales, is generally symmetrical (the late syphilitic papulo-squamous eruption does not usually exhibit this feature), is rarely confined to the palms and the soles, being commonly associated with similar lesions grouped about the extensor surfaces of the knees and the elbows, is always dry, is extremely chronic, is subject to relapses and obstinate to treatment, is not influenced by mercury, and primarily is not associated with other signs or symptoms of syphilis.

Eczema of the palms is attended with discharge, crusting, and itching; it begins about the wrist first, and not in the centre of the palm, and is not as sharply outlined as the specific lesion. When palmar or plantar syphilides become fissured or eroded they cannot be distinguished from eczema. Their reaction to specific treatment is so slow that the therapeutic test is of little service.

The circinate form of papulo-squamous syphiloderm may closely resemble the lesion of tinea circinata; the latter is, however, progressive, and microscopic examination shows the parasite.

Prognosis.—The lesions are obstinate, but ultimately heal; they may leave permanent scarring. Their pigmentation disappears.

Treatment.—Mercury and potassium iodide.

Vesicular Syphilide.—This eruption is exceedingly rare. It may closely simulate, so far as the skin lesions are concerned, almost any of the non-specific vesicular diseases. Thus there are the eczematous form, the varicelloid form, and the herpetic form.

The vesicles may be small or large, may be generalized, or may come out in groups in certain regions of the body. They are prone to appear about the hair-follicles. They are observed on the face, the trunk, and the extremities. If there are seats of preference, these are perhaps the face, genitalia, forearms, and legs.

The eczematous form appears as a general eruption of small vesicles, either discrete or in patches, and generally sparing the face. When the vesicles are discrete, each is surrounded by a characteristic raw-ham-colored areola. If the fluid of the vesicles remains clear, it may break through its thin epidermic wall and escape, or may be reabsorbed, leaving only a slight epidermic exfoliation and temporary pigmentation; frequently, however, pustulation takes place, and thin yellow crusts are formed (impetigo). This last form is prone to appear on the face and about the genitalia, and is usually associated with papular and pustular lesions on other parts of the body.

The diagnosis from vesicular eczema will be made by the characteristic areola, the absence of itching and of acute inflammatory signs, the influence of mercury, and the presence of associated signs of syphilis.

The varicelloid form appears as large, not very numerous, discrete, split-pea-sized vesicles, either globular or umbilicated, which persist for some time, and then rupture, leaving an area of slight crusting and pigmentation. Or they may pustulate (presenting the appearance of varioloid) and crust. The base of each vesicle is surrounded by a characteristic copper-colored areola, and other syphilides are usually present. Were the patient suffering from a well-marked fever, the syphilitic eruption might readily be taken for either varicella or varioloid, according to its type. A history of the case, and the concomitant signs of constitutional syphilis, should quickly establish the proper diagnosis.

The herpetic form of the vesicular syphilide exhibits clusters of vesicles of various sizes, either irregularly grouped or having a distinct circinate arrangement.

The lesions of the circinate form are small, are not persistent, dry up without rupture, and leave an area of superficial exfoliation and raw-ham-colored staining.

The diagnosis from ordinary herpes is generally made without trouble. Yet at times the syphilitic nature of the eruption can be determined only by the associated signs of syphilis. Although syphilitic vesicles as such do not persist for any great length of time, the copper-colored macules or pustules left after the absorption or rupture of the vesicles are liable to remain for many months.

Treatment.—The treatment of vesicular syphilides consists in the administration of mercury, supplemented by mercurial baths to prevent the vesicles from becoming converted into pustules.

Pustular Syphilide.—The syphilitic pustule may be small or large, and either of these varieties may be acuminated or flat.

The lesions are commonly placed on indurated copper-colored bases; they may be surrounded by an extensive dusky areola.

In the early eruptions, and when the lesion first appears, the pus is contained between the raised epiderm and the true skin; later, deeper ulcers may be formed.

These syphilides very closely simulate any of the pustular non-specific skin eruptions. They are prone to crust, the crusts varying from a dark-yellow to a dark-green or brown-black color, and exhibiting, when raised from the surface of the lesion, a distinct punched-out ulcer covered with viscid pus.

When the pustular lesions heal, they leave marked pigmentations, and, unless the ulceration is purely superficial, permanent cicatrices.

Pustules commonly appear late in the disease; their early development is usually associated with a severe form of syphilis.

The pustular syphilides may develop on any skin surface; if the lesions are few in number, they are perhaps more frequently noted on the face, the scalp, and the legs.

Any of the syphilides may be found associated with pustular lesions, and even when the predominant eruption is papular the pustule may be found at the same time in all its forms and at all stages of evolution. An early pustular eruption is especially liable to be preceded by syphilitic fever of an intermittent type, with its associated symptoms of malaise, pallor, inability to concentrate the thoughts, headache, insomnia, articular pains, and sternal tenderness.

The pustular syphilides are somewhat obstinate to treatment, are prone to recur, and are more frequently followed by tertiary manifestations than when the eruption appears in a macular or a papular form. (Bassereau.) When pustulation has been unusually well marked during the secondary stages of the disease the tubercular and gummatous lesions of the tertiary stage of the disease exhibit a marked tendency to suppurate.

Small Acuminated Pustular Syphilide.—This eruption is the most superficial, and usually in its time of appearance the earliest, eruption of this group. It is made up of minute miliary pustules, each situated about a hair-follicle or the opening of a sebaceous gland. It is followed by the formation of small yellowish crusts, leaving a pigmented spot surrounded by a fringe of exfoliating epithelium. On its first appearance the eruption usually covers a large surface, may be discrete or confluent, and exhibits circinate grouping. Relapses of this syphilide are not apt to appear as a general eruption, but rather the lesions will be grouped in certain localities.

When the lesions become confluent, superficial scabs are formed very like those observed in impetigo.' The eruption about the lips is sometimes accompanied by a warty growth. This eruption corresponds closely to the small vesicular syphilide, the only difference being that the raised epidermis has beneath it pus instead of serum.

This pustular syphilide does not last long. Slight crusting takes place, and a pigmented spot is left which is slow to disappear. Sometimes, and this is particularly true of the relapses, ulceration takes place and a permanent cicatrix is left.

Diagnosis.—The diagnosis is founded upon the pigmentation, and is usually rendered easy by the fact that this eruption very rarely appears alone, being commonly associated with papules and roseola.

LARGE ACUMINATED PUSTULAR SYPHILIDE (Fig. 284).—This eruption may develop suddenly, or may form slowly with fever. When the pustules are moderate in size, they so closely resemble ordinary acne that the term syphilitic acne is very generally employed to designate them. The individual lesion begins as a macule, which quickly becomes converted into a papule, then a pustule, commonly placed about a hair-follicle, upon a papular, infiltrated, copper-colored base. The pustule remains for one or two weeks before rupturing. Then crusts are formed, which in dropping off expose either a superficial ulcer or, more commonly, a coppery papule. This and the pigmentation very slowly disappear; usually there is scarring.

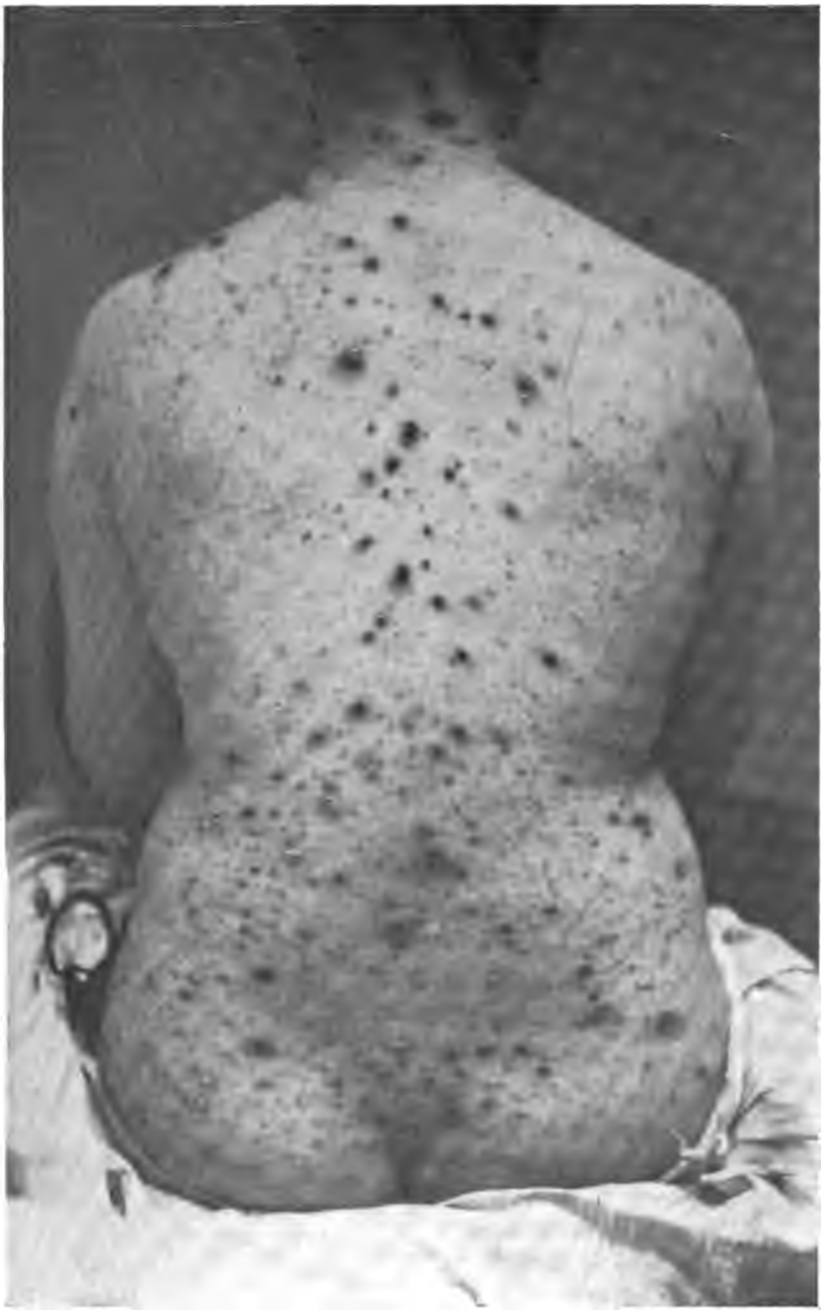
Syphilitic acne may appear as a general eruption; more commonly it invades the scalp, face, and trunk; it is often found on the limbs.

Diagnosis.—The diagnosis of the large acuminated pustular syphilide will be founded mainly on the presence of other signs of syphilis, particularly the other syphilides. Ordinary acne commonly appears on the face, chest, and back, about the age of puberty, being rare in late life, and on the removal of the crusts does not exhibit the coppery, lenticular papule of syphilis. An acne-like eruption confined to the trunk and the legs strongly suggests syphilis.

Variola is a uniform eruption, the lesions all corresponding to the papular, then to the pustular type. It is acute, follows definite well-marked prodromes, runs its course in a few days, and is attended with very pronounced constitutional symptoms. The dorsal surfaces of the wrists and hands and the palms and soles are nearly always affected with papules followed by pustules, and this disease occurs only in those not protected by vaccination. There is little danger of mistaking this eruption for a pustular syphiloderm. An error the reverse of this has been made many times, syphilitic patients having been sent to small-pox hospitals. A diagnosis can be made at times only after one or two days' observation.

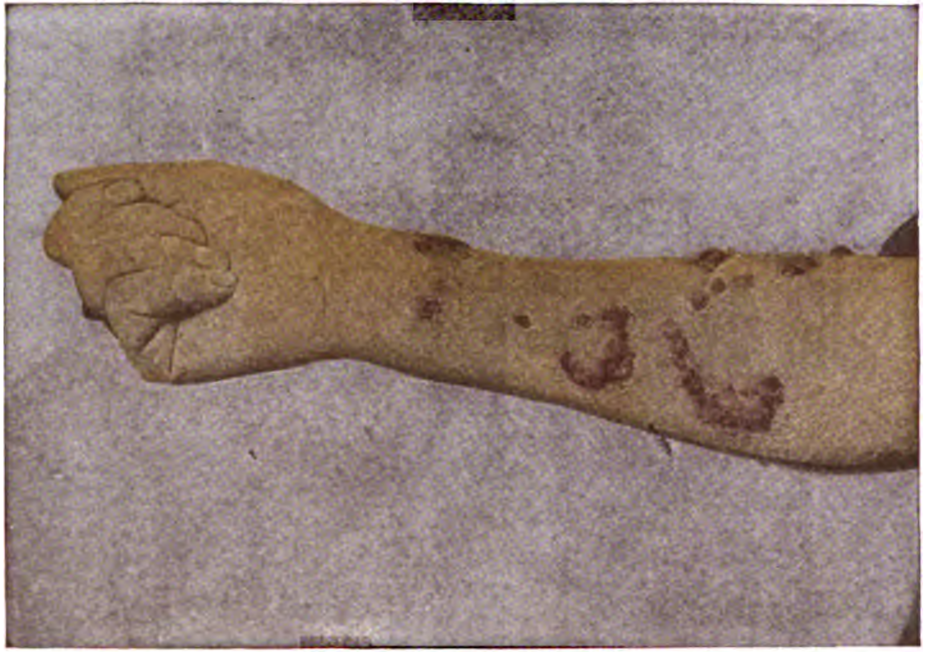
SMALL, FLAT PUSTULAR SYPHILIDE.—The lesions of this form of syphilide closely resemble those of impetigo. They are more com-

FIG. 284.



Large pustular syphilide.
(From the collection of photographs of Dr. George Henry Fox.)

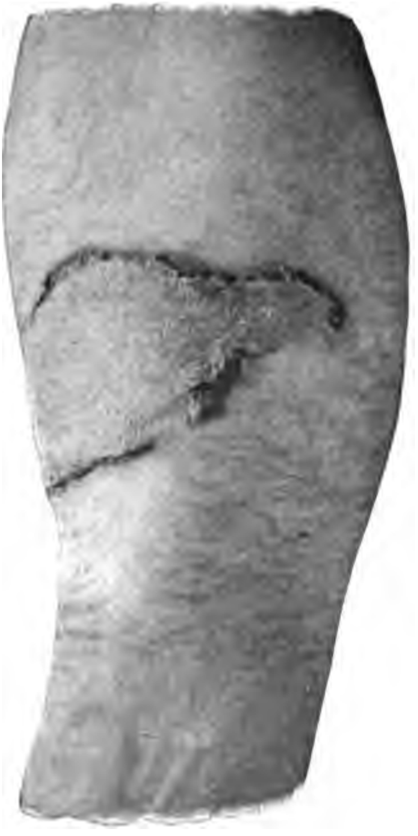
Fig. 285.



Pustulo-crustaceous syphilide. (Fox.)

mon than the acuminated syphilides. Small, flat, split-pea-sized pustules form on somewhat elevated copper-colored bases. These pustules shortly rupture, and are followed by rather thick, adherent, yellowish or greenish crusts. These lesions may be discrete, may exhibit a circinate grouping, or may be confluent, forming irregularly shaped crusts (pustulo-crustaceous). (Fig. 285.) In the latter periods of the disease this eruption commonly appears in the form of irregular patches, often presenting a narrow crusted circinate border, which, spreading peripherally, encloses an area of pigmented, scarred, or normal skin. (Fig. 286.)

FIG. 286.



Pustular syphilide (pustulo-crustaceous). (From the collection of photographs of Dr. George Henry Fox.)

Beneath the crusts of syphilitic impetigo are found ulcers. These may be superficial or deep, the latter variety appearing late in the disease. These ulcers on healing leave depressed, pigmented cicatrices, which are prone to scale for months. The pigmentation finally fades, the scar remaining white.

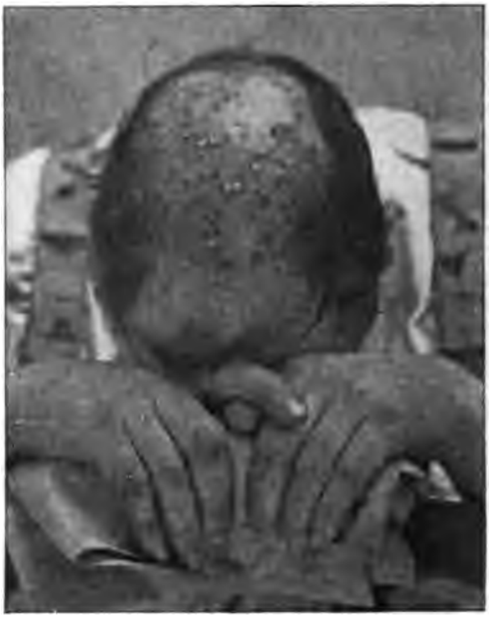
When syphilitic impetigo appears as an early general eruption, it may last but a few weeks. The late confluent circinate and serpiginous forms are extremely chronic.

The favorite seat is the face, especially in the hairy portions, as the beard and the eyebrows, and about the nostrils and lips. (Figs. 288, 289.) They also develop frequently on the scalp (Fig. 287), the chest, and the outer surfaces of the arms and legs. (Fig. 290.)

Diagnosis.—The diagnosis of small, flat pustular syphiloderm is sometimes not possible from the inspection of the lesions alone, the latter corresponding very closely to those of pustular eczema and impetigo.

The crusts of pustular eczema on being raised show an excoriation, and the disease is distinctly more inflammatory in type than the syphiloderm. The pustule of impetigo is discrete, not placed on an infiltrated base, and exhibits no copper-colored areola.

Fig. 287.



Pustular syphilide.
(From the collection of photographs of Dr. George Henry Fox.)

It is mainly by the presence or the absence of associated signs of syphilis that a diagnosis is to be made.

Large, Flat Pustular Syphilide.—The lesions of this syphilide closely resemble ecthyma: hence the eruption is commonly called syphilitic ecthyma. It appears in the form of large, flat pustules, varying from a quarter of an inch to an inch and a half in diameter. (Fig. 291.) The lesion commonly begins as a raised, dusky red, slightly inflamed, and indurated area, which quickly suppurates, the pus raising the epiderm but slightly, and forming a large, flat, not very tense pustule, which shortly crusts.

The lesion may remain superficial, limited, and only moderately crusted, exposing, on exfoliation or removal of the scab, an erosion or a shallow ulceration, or it may extend both in depth and in circumference.

The superficial form occurs towards the end of the first year of constitutional syphilis; it is amenable to treatment, and particularly affects the shoulders, back, and extremities.

Fig. 288.

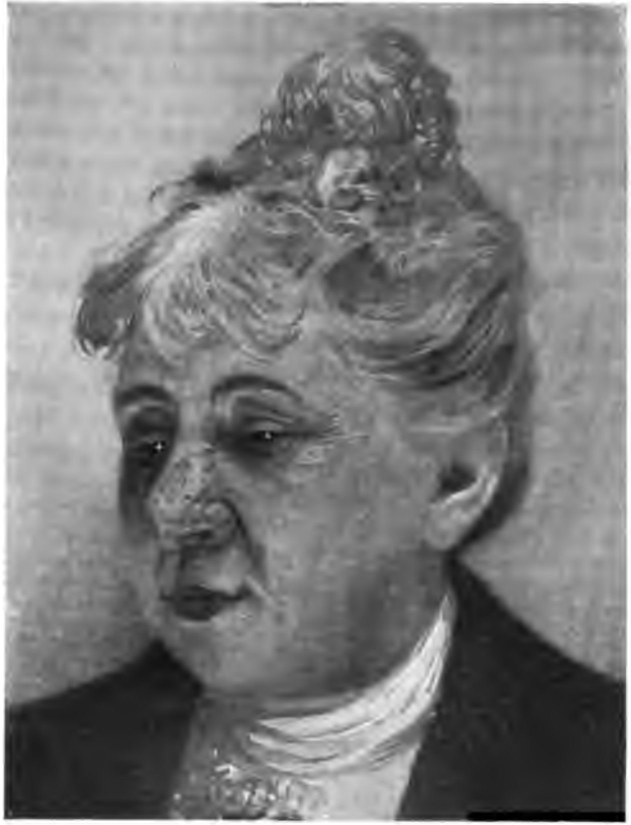
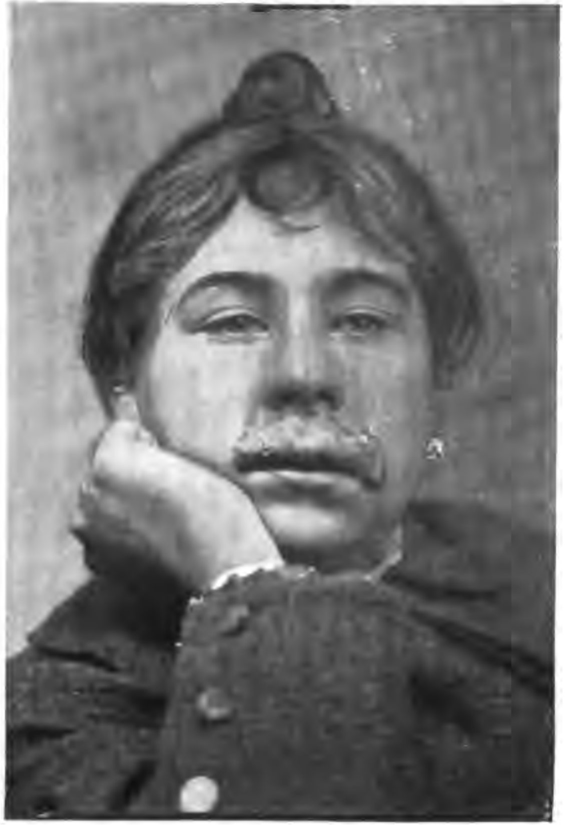
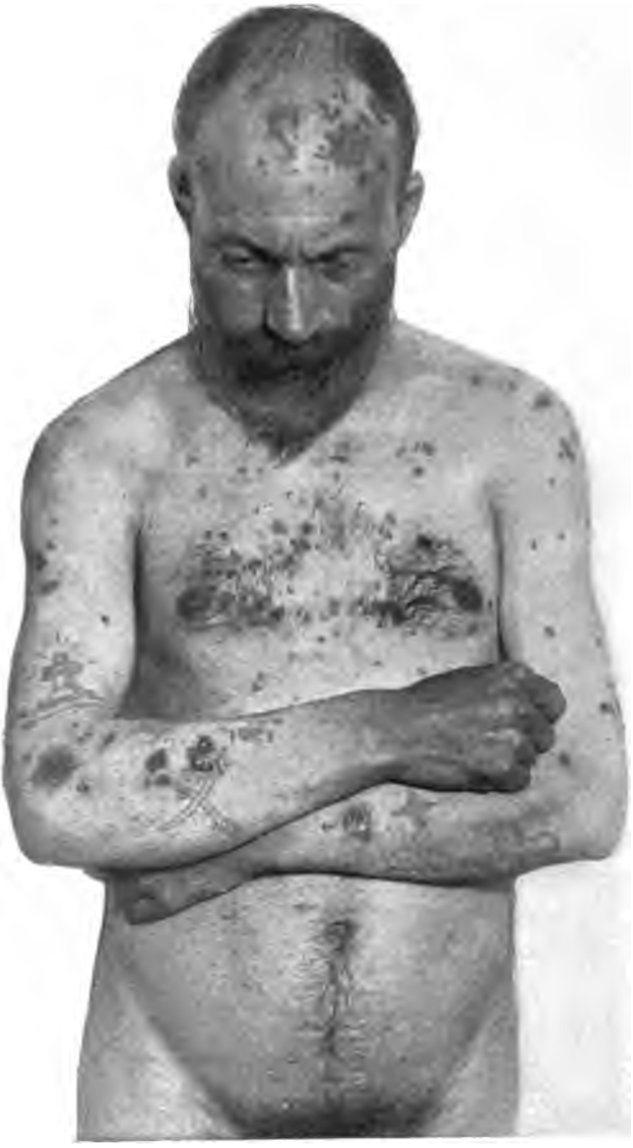


Fig. 289.



Pustular syphilide (pustulo-crustaceous).
(From the collection of photographs of Dr. George Henry Fox.)

Fig. 290.



Flat pustular and papulo-squamous syphilide.

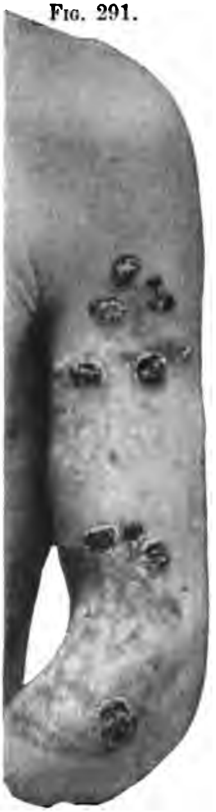
In the deep form of syphilitic ecthyma the ulceration is progressive in all directions. The crust increases in thickness and extent, the material for it being furnished in the continued suppuration of the extending ulcer; it projects from the surface in the form of a greenish or brown-black cone, often exhibiting distinct stratification. This thick, conical, adherent crust commonly overlaps the raw surface beneath; sometimes its base is sunk in the ulcer and is completely surrounded by unhealthy granulations.

Lesions made up of these dark, raised, conical, laminated crusts, seated upon deep ulcers, and surrounded by reddened, indurated areas, are called rupial. When the ulceration extends laterally and does not grow materially deeper, the crust may be depressed in the centre and elevated about the margins.

When the thick crusts of deep ecthyma are removed, punched-out ulcers covered with thick greenish or yellow pus are found. These ulcers are rounded or circular, and usually discrete and few in number. When the pustules are closely grouped they commonly become confluent, the outline of the resultant lesion being circinate.

The chronic crusted lesions of the pustular syphilides are termed pustulo-crustaceous. When they are confluent, spreading widely in circinate forms, and are destructive, they are termed serpiginous. (Fig. 292.)

FIG. 291.



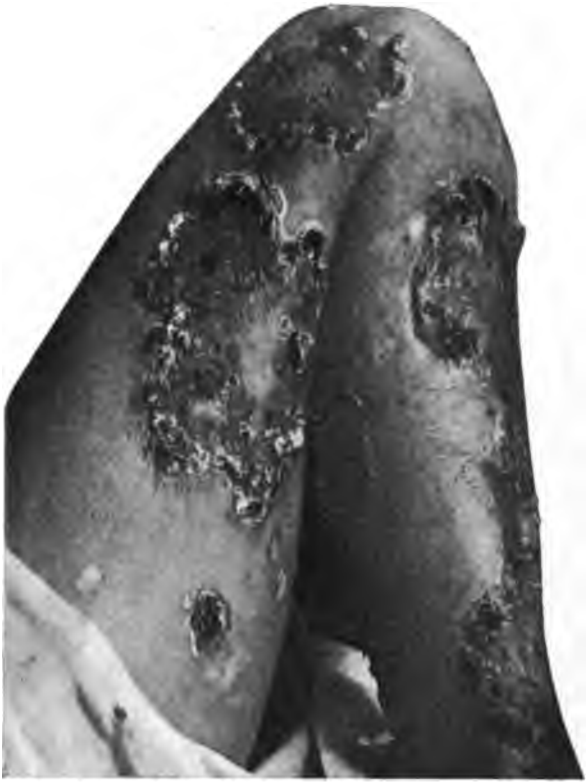
Large, flat pustular syphilide (ecthyma).
(From the collection of photographs of Dr. George Henry Fox.)

Diagnosis.—The diagnosis of syphilitic ecthyma from simple ecthyma will be based largely upon the evolution of the lesions, which in non-specific disease develop rapidly and run their course in a few weeks, are attended with heat, pain, and other symptoms of acute inflammation, form brownish, not very thick, laminated crusts, and exhibit on removal of the latter superficial ulceration in place of the punched-out unhealthy ulcer of syphilis. In ecthyma the eruption is uniform, and there are no coexistent signs of syphilis.

Deep ecthyma leaves permanent cicatrices. Rupial and the other forms of deep syphilitic ecthyma appear as late lesions of syphilis.

All the late pustular eruptions, particularly those which are deep, yield to specific treatment slowly. They usually develop in the cachectic and poorly nourished, and indicate tonic supporting treatment in addition to specific medication and local applications.

FIG. 292.



Serpiginous syphilide.
(From the collection of photographs of Dr. George Henry Fox.)

Pigmentary Syphilide.—The pigmentary syphiiides are quite distinct from the stains secondary to the papular or pustular eruption of syphilis. They are dependent upon a primary excess of pigment, which may subsequently give place to leucoderma, or loss of color. The lesion appears in three forms (Taylor):

1. As rounded, oval, or irregular plaques, with sharply defined or jagged borders, varying from light brown to deep brown.
2. As diffuse pigmentation, which becomes the seat of leucodermatous changes, appearing first as small spots, which gradually increase in size. (Retiform pigmentation.)
3. As abnormal distribution of pigment, some parts of the skin appearing lighter, others darker, than normal. (Marbled pigmentation.)

The pigmentation is unaffected by pressure, the patches are not above the surface of the surrounding skin, and there is no exfoliation. It is usually a secondary manifestation of the disease, developing about the sixth month, though it is at times observed as late as the second or the third year. It is more common in females before middle age. Its seats of preference are the sides of the neck, though it may be found elsewhere, as the chest, the forehead, and the flexor surfaces of the limbs. It lasts for several months, then gradually fades, the skin resuming its natural color. Treatment seems to have no effect upon it.

Tubercular Syphilide.—Tubercular syphilides appear as pinhead- or almond-sized, rounded or flat, hard, copper-colored infiltrations, which invade the entire thickness of the skin, differing in this respect from the papular eruption, and resembling, except in the absence of inflammatory symptoms, a forming furuncle.

The eruption may be generalized, or may occur in patches on certain parts of the body; it may be discrete or confluent; it may be circinate, serpiginous, or irregularly grouped. It may ulcerate, or the infiltrate may become absorbed. In either case there is usually permanent scarring.

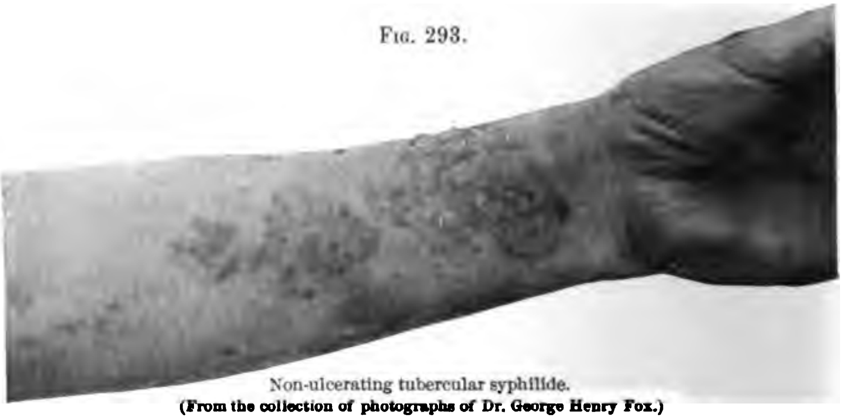
A discrete general eruption is rare; it occurs in the late secondary or in the tertiary period of the disease, rarely before the end of the first year, though exceptionally it may develop within six months of the chancre.

The eruption commonly appears grouped on one or more regions of the body, the indurated lesions having a tendency to coalesce and form circular, scaling, or, if ulceration takes place, eroding patches. Lesions of this kind may develop twenty, thirty, or forty years after the appearance of a chancre. (Bassereau.)

Though the tubercular syphilide may attack any portion of the skin surface, its seats of preference are the face, particularly about the lips and nose, the forehead, the ears, the back, and the legs. The course of this eruption is extremely chronic; it is prone to relapse.

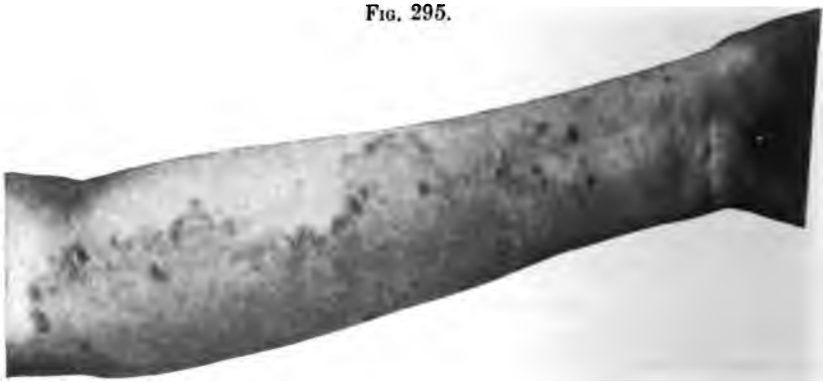
THE NON-ULCERATING TUBERCULAR SYPHILIDE.—The hard, dusky red, chronic, scaling, tubercular eruption, when general and discrete, cannot well be confounded with any other lesion, except the papular syphilide; an error of no great moment, but one which is avoided by noting that the tubercle involves the entire thickness of the skin and appears at a later stage of the disease than does the papule. When grouped, the individual lesions of each group are usually much smaller than the lesions of the discrete general eruption; they tend to coalesce, forming circular or irregular patches (Figs. 293, 294), which increase in size peripherally, while absorption and more or less atrophy of the skin take place in the centre. This results in a raised circular margin made up of tubercles so merged that they can rarely be distinguished as separate tumors, within which lies the depressed, pigmented, atrophic skin. (Fig. 295.) These circles vary in diameter from a fraction of an inch to four or five inches. The surface of the non-ulcerating tubercle may be dry and glistening. More commonly there is a covering of branny scales (tuberculo-squamous syphilide). (Fig. 296.) These lesions develop without subjective sensations, except when situated upon the face. After an alcoholic debauch there may be marked local inflammatory phenomena in lesions thus situated.

FIG. 293.



Non-ulcerating tubercular syphilide.
(From the collection of photographs of Dr. George Henry Fox.)

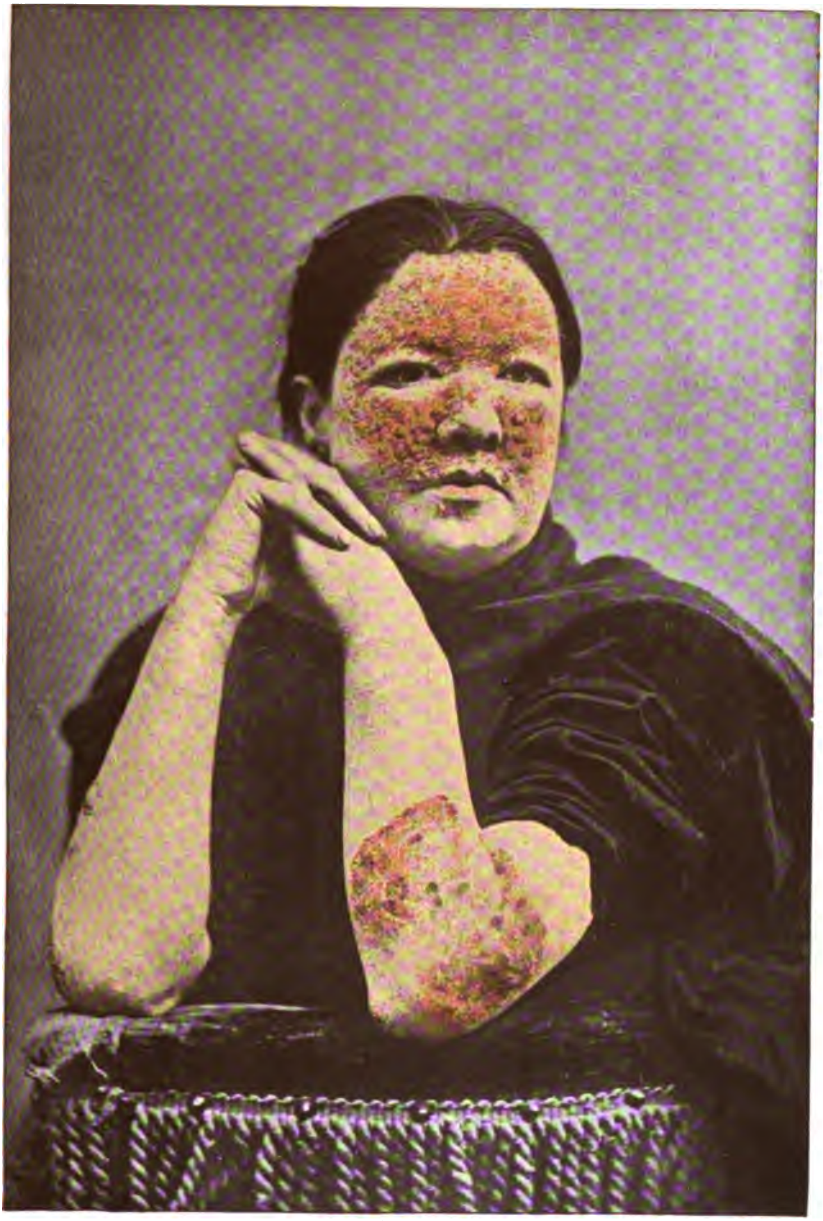
FIG. 295.



Non-ulcerating tubercular syphilide.
(From the collection of photographs of Dr. George Henry Fox.)

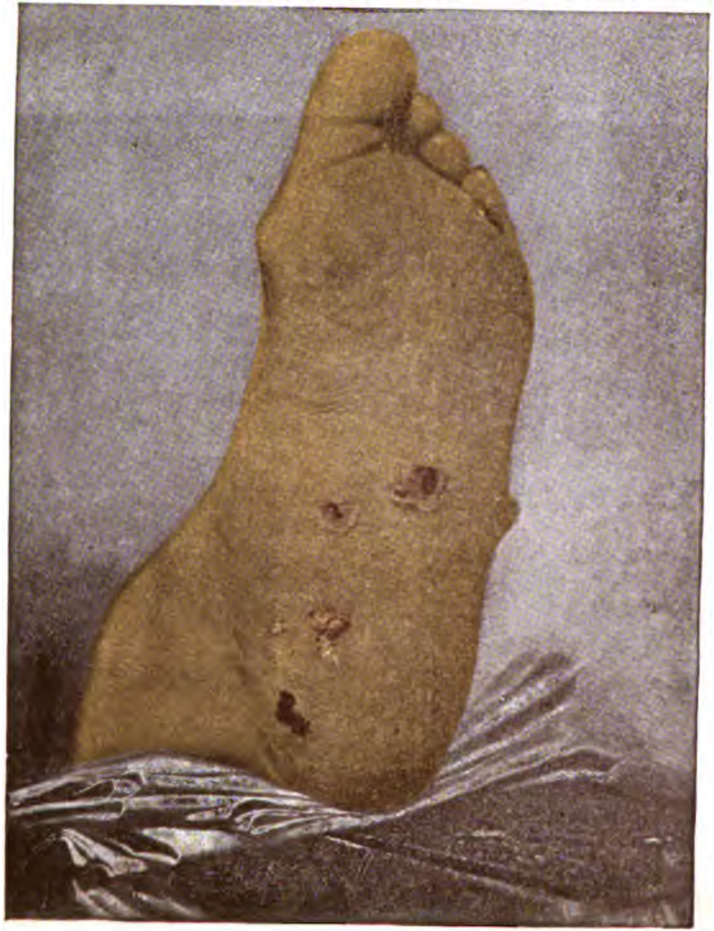
The tubercles are resistant to treatment, often lasting for months. They may form permanent scars, incident to a process of interstitial

FIG. 294.



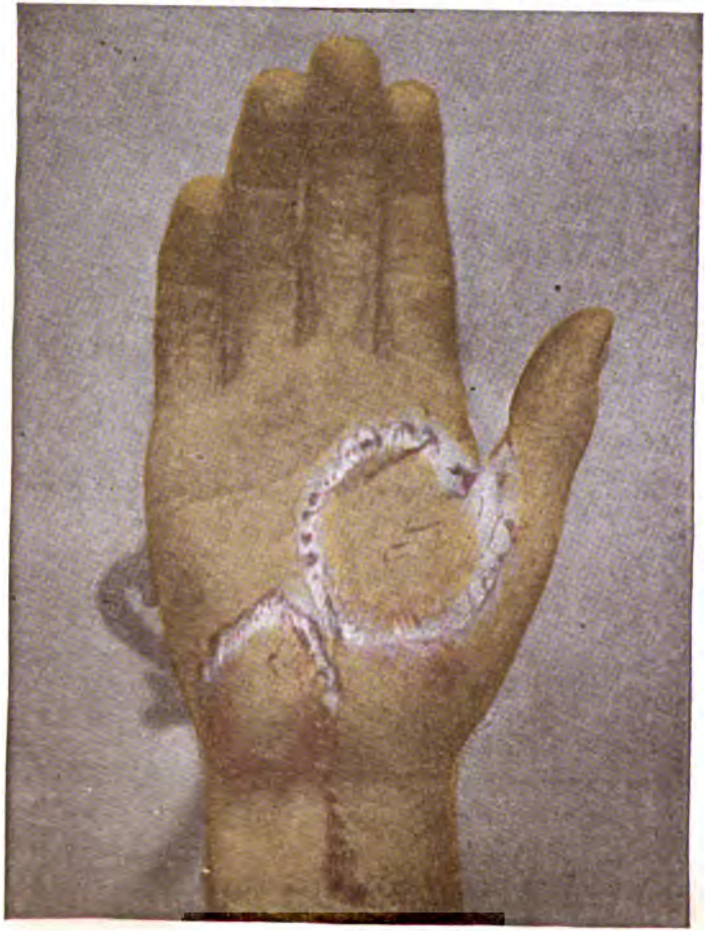
Tubercular syphilide. (Fox.)

Fig. 297.



Ulcerating tubercular syphilide. (Fox.)

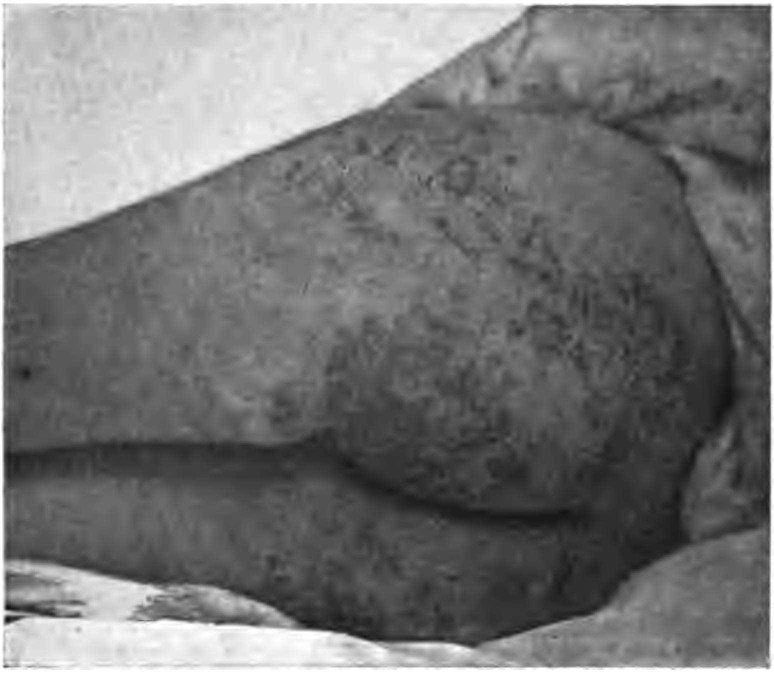
Fig. 298.



Squamous circinate syphilide. (Fox.)

absorption. These scars are at first brown or copper-colored; ultimately they become white.

FIG. 296.



Tubercular (squamous) syphilide.
(From the collection of photographs of Dr. George Henry Fox.)

ULCERATING TUBERCULAR SYPHILIDES are much more serious than the dry tubercular eruption, both in their immediate effects and from a prognostic stand-point. The dry lesion after persisting for months may break down; more commonly the tubercle from the first shows a tendency to crust. This form of eruption is rarely general, commonly affects certain regions of the body, exhibits a round grouping, and may invade a large surface.

The ulceration may be superficial, attended by a slight scabbing and followed by very little scarring; or it may be deep, invading the entire thickness of the skin (Figs. 297, 298), may be covered by thick scabs (Fig. 299), and may be followed by dense cicatrices, which cause both disfigurement and disability.

The ulceration extends slowly, healing with the formation of scar-tissue in one place while breaking down is taking place in another. This process may continue for months or years, the diseased area forming circles, broad bands, or irregular figures (Fig. 300), and involving a large surface. Thus the entire face may be disfigured by the lesion. This form is called serpiginous. It is, of course, not exempt from the microbic invasion to which all open surfaces are exposed, and as a result of infection may become phagedenic, the ulceration extending with extreme rapidity and destroying a large amount of tissue in a few hours.

The face and back are the favorite seats of serpiginous syphilides.

As in other forms of syphilitic skin eruptions, in place of ulceration and destruction there may be hypertrophy, the skin papillæ growing from the ulcerated surface of a tubercle to form a pus-secreting cauliflower growth.

Frequently the cicatrices of ulcerating tubercular syphilides are pathognomonic of the specific lesions; in the midst of the large scars can be seen the small, depressed, round cicatrices of the individual tubercle.

Diagnosis.—The diagnosis of the tubercular syphilide must be made from lupus vulgaris. Lepra and carcinoma are also closely simulated by this syphilide.

The main diagnostic points between ulcerating tubercular syphilide and lupus vulgaris are as follows:

Tubercular Syphilide.	*Lupus Vulgaris.*
Tubercular syphilide generally occurs in adults who give a history of syphilis or exhibit signs of other syphilitic lesions.	Lupus vulgaris generally occurs, or at least first appears, before the twentieth year of life, without history or signs of syphilis.
Begins as a copper-colored or brownish tubercle, which becomes a characteristic ulcer in one or two months.	Begins as a tubercle, which does not ulcerate to the same extent for many months or even years.
The tubercles are of a brownish-red or coppery color, and are comparatively large.	The tubercles are often translucent, of lighter color, and are small.
The skin is distinctly infiltrated through its entire thickness.	The infiltration of the skin is not so marked.
Ulcers, if distinct, are small, circular, punched out. If confluent, they involve a large area. The secretion may be copious and offensive.	Ulcers are rarely distinct. They are superficial, are not punched out, exhibit no regular form, and seldom involve large areas. The secretion is slight and not offensive.
The crusts are bulky and greenish or brownish black.	The crusts are thin and dark red.
The scabs are irregular in shape and attachment.	The scabs are arranged more regularly, attached in the centre, and loosened at the edges.
The scars are soft, white, and circular. Local treatment is ineffective. Internal specific treatment effects a cure.	The scars are distorted, irregular, and puckered. Active surgical intervention is effective. Internal specific treatment is without effect.

Fig. 299.

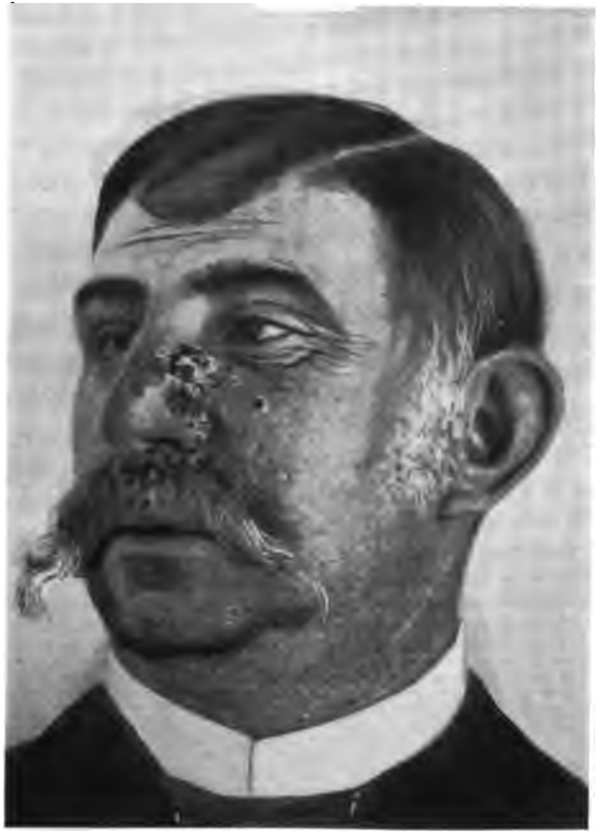
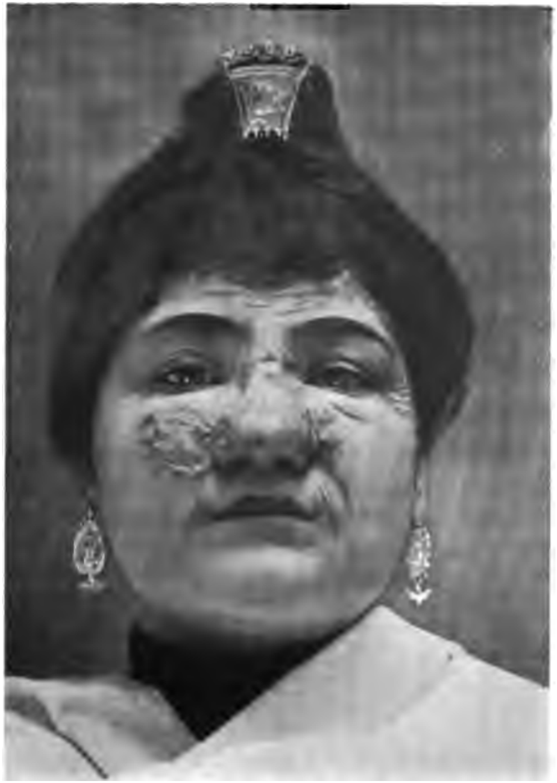
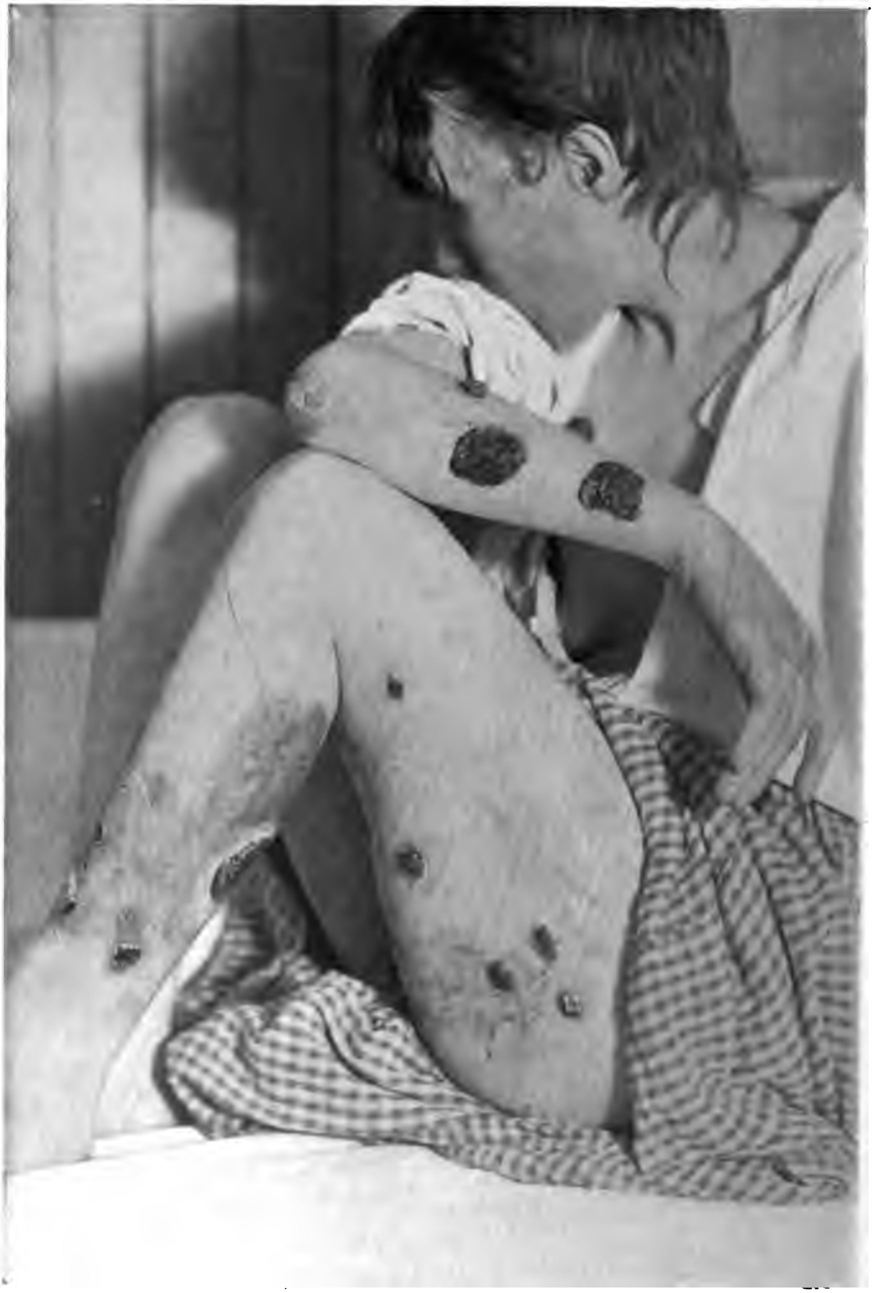


Fig. 300.



Tubercular syphilide.
(From the collection of photographs of Dr. George Henry Fox.)

Fig. 301.



Syphilitic rupia following the bullous syphilide.

Aside from the history of the case, the most important points to be considered in differentiating between lupus and syphilis are the early age at which lupus begins, its very slow course, its superficial ulcerations, and its cicatrices, which exhibit neither the characteristic coppery stains nor the many small, depressed, circular scars of ulcerating tubercular syphilides.

Cancer is sometimes closely simulated by the tubercular syphilide. The slow growth, the steady progress without attempt at cicatrization, the scanty discharge, the lancinating pains, the lymphatic involvement, the absence of signs or history of syphilis, and the resistance to specific treatment, are symptoms which will generally lead to a correct diagnosis.

The Bullous Syphilide.—This eruption usually appears as rounded or oval, discrete blebs surrounded by a slight areola, varying in size from that of a split pea to that of a penny. The clear serum contained within the bleb shortly becomes turbid and blood-stained or even distinctly purulent. On rupture of the blebs, the contents form dark-yellowish or greenish-black scabs. These, growing from the bottom, by the drying of the freshly secreted pus of the slowly enlarging ulcer, finally result in raised, conical, imbricated crusts, often half an inch to an inch in height, and sometimes twice as much in diameter. (Fig. 301.) These crusts are adherent, and usually overlap and conceal the underlying ulcer, though sometimes they may be set in the latter as a watch-crystal is set in its rim. Unless mechanically disturbed, they generally remain till the ulcer is healed. If they are removed, a deep, punched-out, unhealthy, granulating surface is exposed, covered with black, sanious pus.

The bullous syphiloderm is commonly found in broken-down subjects, and is significant of an inveterate form of syphilitic poisoning. The crusted ulcers following bullæ or pustules form the typical rupial lesion. The crusts of rupia are large, and are thicker and darker than those of any of the syphilides. The ulceration involves the entire thickness of the skin, and often extends over a large surface.

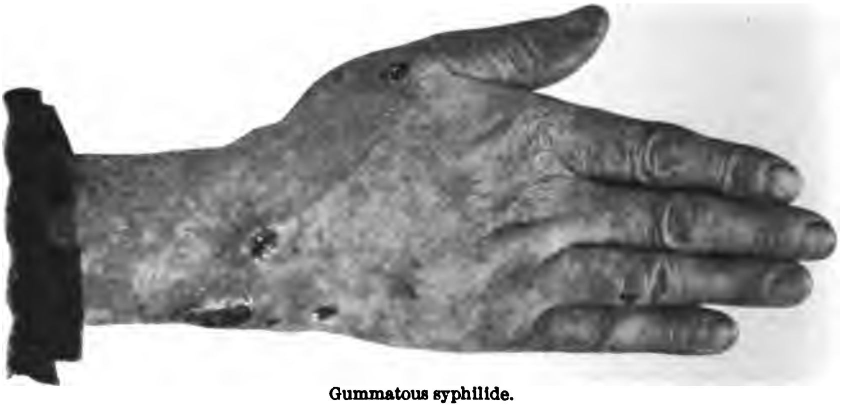
The scars left by rupia are similar to those of deep ecthyma. The eruption is encountered in the tertiary stage of the disease, and is one of the most characteristic lesions of syphilis.

The Gummatous Syphilide.—Though gummata of the skin exceptionally appear in the first six months of syphilis, in such cases indicating a grave form of the disease, they commonly develop three or four years after the chancre.

Gumma differs from the lesions already described in the fact that it is a true tumor or granuloma, which, having once developed, in whatever way it terminates permanently affects the seat of invasion.

The favorite localities of the gummatous syphilides are the face, particularly the forehead, arms, forearms, the anterior surface of the tibia, particularly the upper third, the skin overlying the sternum and clavicle, the scrotum, the penis, the external genitalia of women.

Fig. 302.



Gummatous syphilide.
(From the collection of photographs of Dr. George Henry Fox.)

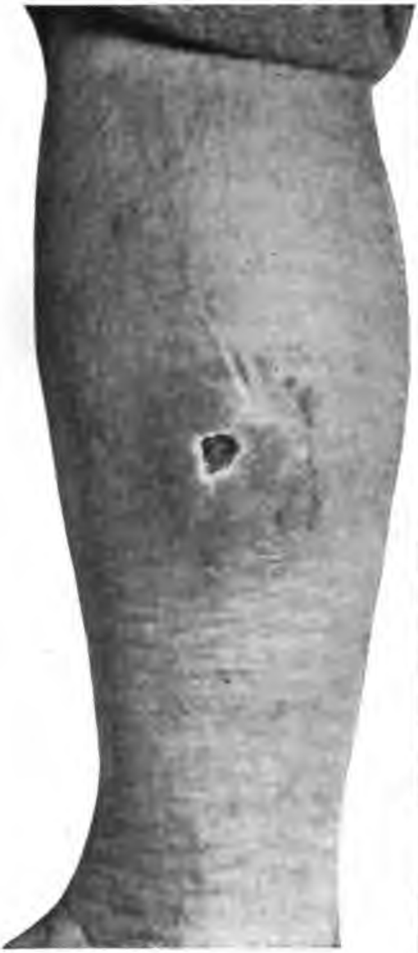
Gummata of the skin commonly appear as rounded, painless, subcutaneous nodules, freely movable, and varying in size from that of a pea to that of a cherry. These slowly grow, reddening, infiltrating, and softening the superficial layers of the skin and breaking down to form deep, undermined, sloughing ulcers. (Figs. 302, 303, 304.) Sometimes the gumma begins as a circumscribed infiltration of the skin instead of a distinct subcutaneous tumor.

The gumma goes through the stages of: 1. Formation, usually of long duration and unattended by pain. 2. Softening, fluctuation being felt when the tumor has reached its full size (from that of an almond to that of a hen's egg). 3. Ulceration; the skin becomes discolored and perforated, and a small quantity of puriform, gummy liquid is discharged. 4. Reparation; after extrusion of the slough granulations form, growing centrally from the periphery of the ulcer.

When the gumma opens there is at once an escape of mucilaginous liquid. The partially disorganized infiltrate adheres by its deeper portions to the subcutaneous cellular tissue, and is subsequently thrown off in the form of sloughs. By the process of ulceration a number of contiguous gummata may coalesce, forming one huge cavity, with irregular sloughing walls.

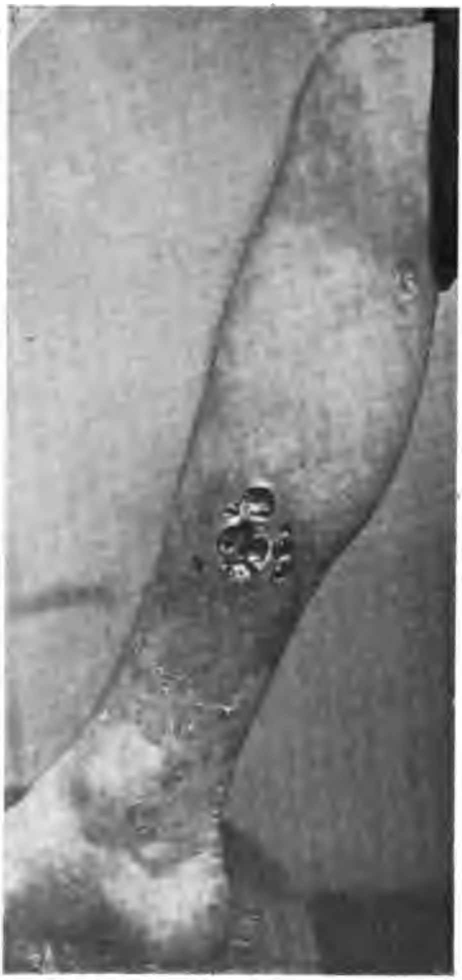
Though the stage of formation is slow and painless, the patient often noticing the tumor only by accident, softening and ulceration may progress with great rapidity. Thus, Bassereau states that a small, indolent, subcutaneous nodule of the nose or ear has in a single night undergone extensive destructive ulceration, producing permanent disfigurement.

Fig. 303.



Single ulcerating gumma.

Fig. 304.

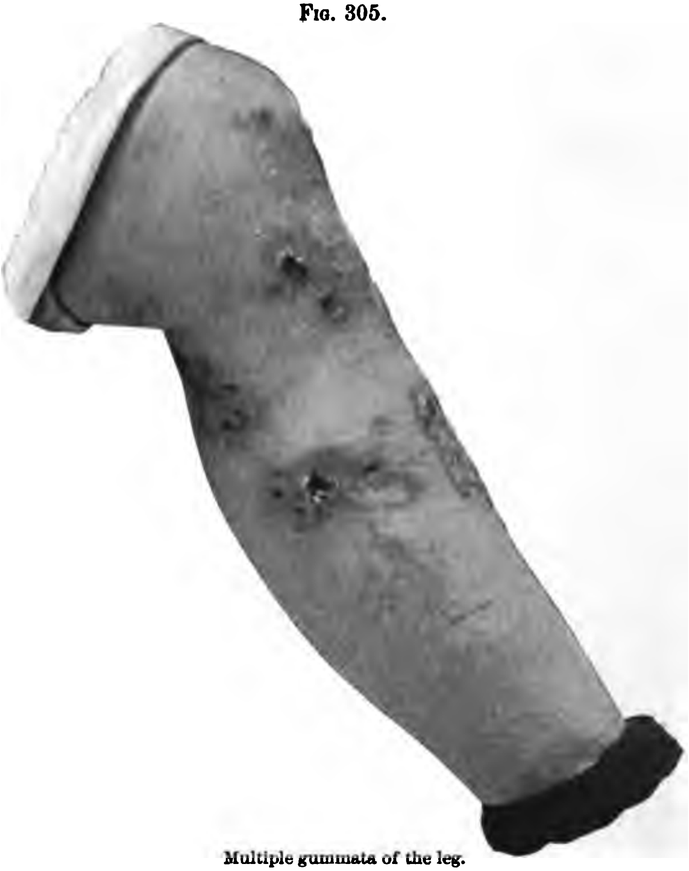


Ulcerating gummata becoming confluent.
(From the collection of photographs of
Dr. George Henry Fox.)

The gumma may be single or multiple. In the latter case there are rarely more than half a dozen. (Fig. 305.) Exceptionally several dozen may develop, either simultaneously or following one another, usually showing a circular or circinate grouping and exhibiting a tendency to coalesce, forming a diffuse infiltration, which on ulceration may discharge by several openings through the blue undermined skin.

The middle of the forehead is a favorite seat of gummata. One or several nodules may develop. They commonly involve the underlying bone, producing caries, which may extend through its entire thickness, exposing the dura. Exceptionally there develops a deep and diffuse infiltration of the face, causing great thickening of the skin and presenting the appearance of leontiasis. Acute inflammation of this infiltrate is especially liable to occur in drunkards, and leads to extensive destruction of tissue and consequent deformity, and exceptionally to violent hemorrhage from erosion of blood-vessels.

FIG. 305.



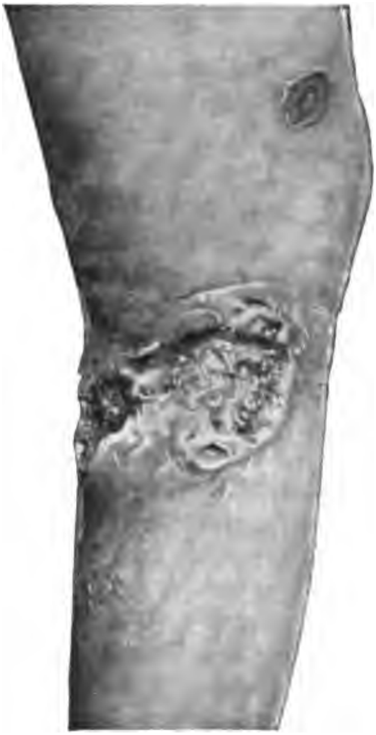
Multiple gummata of the leg.
(From the collection of photographs of Dr. George Henry Fox.)

These gummatous infiltrations are sometimes transformed to tuberculous or cancerous lesions.

Gummata of the extremities may be single or multiple. As they appear on the leg they are commonly multiple, and have for their seats of predilection the anterior and lateral surfaces of the upper third and the malleolar regions. When placed here they break down readily and are subject to infectious inflammations. (Fig. 306.) They are extremely obstinate to treatment, and ultimately assume the chronic indurated appearance of ulcers due to other causes, particularly when they are near the malleoli. (Fig. 307.) Gummatous syphilides when they develop over the clavicle and sternum are often associated with underlying periostitis and ostitis. Because of this, when they have ulcerated they are difficult to cure.

The prepuce may be affected by either diffuse gummatous infiltration or individual nodules. In either case the diagnosis from primary lesion can be made from the fact that infiltration preceded ulceration. Single ulcerating gummatous lesions of the glans penis may exactly simulate chancre. The inguinal glands do not, however, share the characteristic enlargement of the primary lesion, and the development of the lesion and the history of the case usually point to the true diagnosis.

FIG. 306.

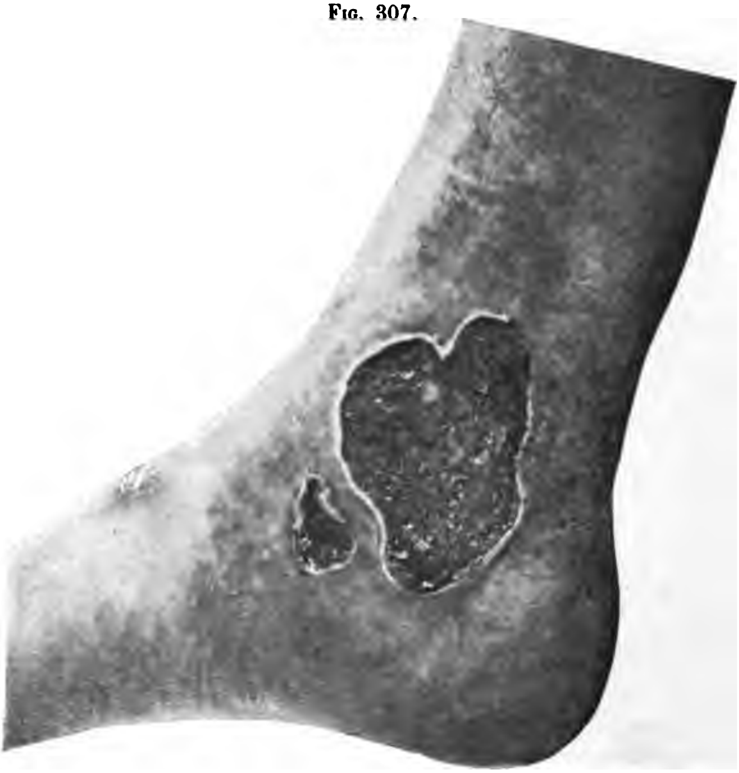


Sloughing gumma of the leg.

The gummatous ulcer may become serpiginous or phagedenic. The necrosis involves not only the imperfectly organized, round-celled infiltrate of gumma, but also the anatomically associated tissues, often exposing and eroding bone, destroying tendons and muscles, opening mucous channels, and resulting in disfiguring and disabling cicatrices. In the scrofulous, gummatous ulcers are particularly persistent. Exceptionally these ulcers exhibit papillary outcroppings presenting an appearance much like that of epithelioma. From the scars of these ulcers epitheliomata sometimes develop.

Diagnosis.—A history of syphilis, or concomitant signs of the disease, and the typical development of a painless infiltration at the seats of predilection, should establish the diagnosis of gumma. As this lesion is a late tertiary symptom, it may stand alone as an expression of the constitutional disease, since too often a clear history is wanting both of preceding syphilis and of the mode of onset of the gumma.

FIG. 307.



Ulcerating gummata of the malleolar region.
(From the collection of photographs of Dr. George Henry Fox.)

When the tumor is seen during the stage of infiltration it may simulate benign tumor or sarcoma so closely that diagnosis can be made only by the therapeutic test or by keeping the growth under observation a sufficient length of time to note its mode of development. The alleged cure of sarcoma by mercury clearly shows the difficulty in making a correct diagnosis from one examination.

When the gumma has ulcerated and exhibits papillary outgrowths it may resemble epithelioma almost exactly. The mode of onset is, however, different, epithelioma beginning as a wart or an ulcer, and not as an infiltration. Microscopical examination of a portion of the removed growth and the effect of specific treatment should definitely and promptly settle the diagnosis.

The cicatrices of healed gummata are depressed and adherent to deeper structures.

SYPHILITIC AFFECTIONS OF THE APPENDAGES OF THE SKIN.

Syphilitic Alopecia and Onychia.—SYPHILITIC ALOPECIA appears with the early secondary symptoms,—*i.e.*, about the third month from the development of the chancre; it may develop much later. There may be total or partial loss of the hair. Total loss is rare. Partial loss may develop in the form of a general shedding, the hair coming out readily and the resultant appearance of the scalp simulating that of advancing baldness from other causes. More characteristic is the shedding of hair in irregular, usually rounded, scaling patches, giving the scalp a typical moth-eaten appearance. Both the general and the circumscribed alopecia are often associated with papular and papulo-pustular lesions of the scalp. As has been stated, the prognosis of these forms of alopecia is favorable, the hairs growing again on the absorption of the infiltrate which interferes with their nutrition.

Circumscribed alopecia due to ulcerating and tubercular syphilides is permanent, since the lesions entirely destroy the hair-follicles. (Fig. 308.)

The diagnosis of specific alopecia is founded on the rapidity of the process, the history of syphilis and associated symptoms of the disease, and the patchy, moth-eaten appearance of the scalp, the bare spots showing prominent follicles and a scaling surface. When the alopecia is partial, shedding of the hair is most noticed over the posterior portions of the scalp, thus differing from ordinary baldness.

In addition to vigorous constitutional treatment, shampooing, massage, and active counter-irritation are indicated.

ONYCHIA is due to the influence of the syphilitic poison on the matrix of the nail and on the periungual and subungual epidermic tissue. The term paronychia signifies that the tissues surrounding the nails are involved primarily. The nails become dry, brittle, lustreless, and break on the least pressure (friable onychia). They may be fissured and loosened from their matrices, to be finally shed completely, giving place to a new nail. Sometimes the nail becomes greatly discolored, thickened, and distorted (onychia hypertrophica).

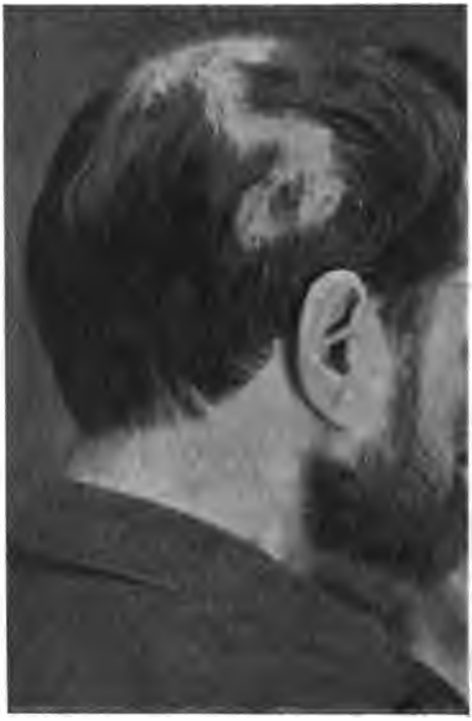
These forms of onychia are usually observed in the early secondary period of syphilis. They are painless, non-inflammatory, and produce no permanent deformity, the new nail-tissue being healthy in appearance when active constitutional treatment has succeeded in overcoming the specific virus. The nails of the fingers are more frequently attacked than those of the toes.

The treatment is constitutional. Local treatment, except cleanliness and protection, is without effect.

Paronychia, or inflammation in the tissues around the nails, may be *dry* or *moist*.

The *dry paronychia*, or non-ulcerative form of the affection, is commonly associated with the papular syphilides. It begins either as a papule which involves the cutaneous folds, occasioning horny thickening and exfoliation of the epidermis, or as an infiltration surrounding the nail, much as would an ordinary "run-around," except that it is chronic in its course, painless, and exhibits a deep coppery color. In either case the nail is often brittle, cracked, and deformed.

Fig. 308.



Syphilitic alopecia following ulcerative lesions.
(From the collection of photographs of Dr. George Henry Fox.)

Moist paronychia, or the ulcerating form of the affection, is often associated with the vesicular or pustular syphilides. It begins as in the dry form, but goes on to ulceration, the infiltrate becoming fissured and suppurating. As a result there is found about the periphery of the nail, and frequently undermining it, an unhealthy ulcer, the granulations of which may become exuberant. There may be swelling of the extremity of the digit as marked as that observed in felon.

Diagnosis.—The diagnosis of syphilitic paronychia is founded on the painless, chronic course of the affection, the absence of acute inflammatory symptoms, and the presence of other signs of syphilis.

The nail is frequently shed, and, if the ulceration has been sufficiently deep to destroy the matrix, will not be reproduced. It usually grows again, but is shrivelled and deformed. The infiltrate may remain for many months.

Treatment.—The treatment of ulcerating paronychia is primarily that suited to the management of secondary syphilis. The local treatment must be conducted on general surgical principles. Prolonged immersion in weak, hot bichloride solution (1 to 2000), followed by the application of moist compresses wrung out of the same solution and kept from drying by the application of waxed paper or oiled silk, will aid in rendering the ulcerating surface clean and will promote healing.

When the granulations are indolent and exuberant, forming a mushroom-like growth, they may be thoroughly curetted, or their surface may be sprinkled with dry powdered lead nitrate, an ordinary gauze dressing being applied over this. When ulceration has undermined the nail, the latter should be trimmed away sufficiently to allow thorough local treatment to be applied to the entire diseased surface. Iodoform and aristol are both useful applications, but only when they are brought in direct contact with the ulcer. When cicatrization has taken place, careful strapping with thin strips of resin adhesive plaster, repeated daily, will encourage the formation of a symmetrical nail.

SYPHILITIC LESIONS OF THE MUCOUS MEMBRANE.

The mucous membrane manifestations of syphilis correspond in pathology and general features with those appearing on the skin, the difference depending upon increased vascularity, diminished resistance to extension and ulceration on the part of the surrounding macerated mucous membrane, and a greater or less degree of irritation incident to secretions which are constantly brought in contact with the lesions.

Erythematous Syphilide.—This attacks the throat, the vagina, the urethra, the glans penis, and the inner surface of the foreskin. It may develop on any mucous surface of the respiratory, digestive, or genito-urinary tract. As in the case of the corresponding skin eruption, the lesions first appear as discrete spots; these become confluent in a few hours, exhibiting then a somewhat sharply circumscribed circinate margin.

The mucous membrane of the throat is most frequently attacked, the patient suffering from syphilitic angina, which may assume the acute or the chronic form. The hyperæmia and œdema involve the pharynx, tonsils, half-arches, and soft palate, but rarely extend to the hard palate, though the latter may exhibit discrete macules.

So quickly does the macular eruption of the mucous membrane become confluent that, when first observed, the lesions depending upon their location closely simulate simple sore throat, balanoposthitis, vaginitis, or urethritis. It is most important to recognize the syphilitic nature of such lesions, since they may appear before other more characteristic secondary symptoms, or as the only manifestation of the disease, and since their discharges are contagious.

Diagnosis.—The diagnosis will usually be founded on associated signs or symptoms of syphilis, and on the absence of a cause for simple inflammation. There is nothing typical or characteristic in the local appearance.

Papular Syphilide.—The papular eruption upon the mucous membranes may appear as a denudation or erosion, as a circumscribed diphtheroid patch, as a vegetating papule, as a superficial ulceration, or as a scaly patch. These lesions are more prone to recur than the homologous lesions of the skin, and are more obstinate to treatment.

They are exactly simulated by the papular syphilide, as it develops about the mucous orifices, on the scrotum, beneath the breasts, or in any region where heat, moisture, and friction modify the eruption.

All forms of papular eruption are classed under the general heading of mucous patches, though this term is often limited to lesions covered by a gray-white pseudo-membrane or to the later scaly eruption of the mucous membrane.

The *papular erosion* appears in the form of oval or rounded, small or large, infiltrated patches, exhibiting a raw-ham color, denuded of epithelial covering, and showing a smooth, glistening surface. It is usually placed on the dorsum of the tongue, and associated with it are found fissures of the borders of the organ, and mucous patches.

It is particularly common in inveterate smokers and hard drinkers; and, indeed, this is true of all the mouth lesions of syphilis.

The *diphtheroid papule*, the commonest form of the mucous patch, appears as a small or large, discrete or confluent papule covered with a tightly adherent, gray-white pseudo-membrane, which on being removed leaves a bleeding surface. The diphtheroid membrane is but little elevated above the level of the surrounding healthy surface. It is somewhat sharply defined from the latter by a narrow hyperæmic zone often exhibiting the dusky-red coloration of syphilitic lesions. There may be central absorption of the infiltrate and healing in this portion of the lesion while there is extension at the periphery, thus producing ring-like and serpiginous figures.

This form of mucous patch is generally found on the mucous membrane of the cheeks and lips and at the angles of the mouth, where it becomes fissured, on the sides, under surface, and frænum of the tongue, on the gums, and on the soft palate, half-arches, and tonsils.

The lesions may be attended with fissuring, with superficial ulceration, and, when situated on the tonsils, with deep and destructive ulceration. Under these circumstances they may become extremely sensitive, interfering with eating or drinking, or even speaking, and occasioning an annoying flow of saliva.

When the mucous patch is undergoing involution, either under the influence of constitutional or local treatment or spontaneously, and loses its diphtheroid covering, it presents the appearance of a papular erosion, then heals over, exhibiting a temporary pigmentation.

When these diphtheroid papules become distinctly inflammatory in type they may react upon the anatomically related lymphatic glands, producing enlargement, and in some cases, from mixed infection, suppuration.

The *vegetating papule* exhibits the tendency towards local hypertrophy which is sometimes a marked feature of syphilitic lesions.

The infiltration common to all the lesions of syphilis is in the case of this manifestation of the disease particularly well marked; in addition, the papillæ of the mucous membrane are greatly hypertrophied; there results a raised lesion, which is in reality an infiltrated papilloma, varying in size from that of a split pea to that of a half-walnut.

The surface of this lesion may be covered with a gray-white false membrane, or may present an eroded appearance. The lesions have a marked tendency towards peripheral extension, and when several are placed near together these are likely to become confluent.

The vegetating papule is comparatively rare upon mucous membranes. It is commonly encountered about the vulva in women and in the anal region in men. From infiltration the surface upon which these lesions are placed loses its elasticity, so that rhagades or fissures are likely to occur.

Superficial ulcerations are frequently associated with the vegetating papules; these represent infiltration in which there has been destruction of tissue, a distinct, punched-out, freely secreting ulcer occupying the site of a lesion which in its early stages presented the appearance of a vegetating papule. This ulcerating lesion is more frequently encountered upon the skin than upon the mucous membranes.

PAPULO-SQUAMOUS SYPHILIDE.—The *scaly patches* (mucous psoriasis, opaline plaques) rarely appear in the course of constitutional syphilis. They are rounded or irregularly shaped, flat, smooth, bluish-white patches, such as would result from lightly brushing a surface with strong silver nitrate solution. The white coloration is due to changes in the epithelium, consequent on chronic irritation and inflammatory infiltration. The normal columnar cells are replaced by squamous epithelium arranged in many layers, producing a species of cornification identical with that described when considering the pathological changes incident to chronic urethritis; as the thickening is greatest at the centre and becomes less marked towards the periphery, so the color shades into that of the surrounding mucous membrane. The thickened epithelium is itself adherent to the underlying surface, but its removal does not occasion bleeding. Frequently the central thickened epithelium exfoliates, while the lesion extends peripherally, leaving either a surface of hypertrophied and infiltrated papillæ, a distinct erosion, or even healthy mucous membrane surrounded by a white ring of epithelium. From confluence of such patches curious markings are sometimes observed on the tongue.

This lesion is most frequently observed on the buccal mucous membrane, along the alignment of the upper and the lower teeth when the jaw is closed, the patches usually being more or less confluent. It also develops on the inner surface of the lips, and on the dorsum, sides, and under surface of the tongue.

As with other lesions of syphilis, there is little pain excited by white scaly patches, except where they are associated with fissures and ulcerations.

Unlike the other forms of papular eruption, the scaly patch usually denotes a late stage of the disease. It may develop at any time in the late secondary and tertiary periods, and is usually exceedingly obstinate to treatment.

Gummata may develop in tertiary syphilis, both in the mucous membrane and in the submucous connective tissue. They may take the form of diffuse infiltrations or of circumscribed tumors.

The mucous gummata appear as small tumors, which rarely reach the size of a pea before breaking down, forming punched-out, unhealthy ulcers, about the circumference of which is often to be noted a raw-ham-colored infiltrate.

These lesions peculiarly affect the hard and the soft palate, and often exhibit a serpiginous grouping and a slow extension in one direction while cicatrization is taking place in the ulcer which first developed.

The submucous gummata form larger tumors before breaking down. They exhibit, however, a marked tendency to soften towards the surface, producing deep, punched-out ulcers with infiltrated borders.

The ulcerating gummata are responsible for the stenosing cicatrices which may develop in nearly any portion of the alimentary canal, though they are most frequently recognized in the œsophagus and the rectum.

Diagnosis of Mucous Syphilides.—To distinguish the erosive and diphtheroid forms of the mucous patch from the ulcers of simple aphthæ is, from the appearance of the lesions alone, impossible. Aphthæ, however, are generally more tender, more liable to be discrete, develop in a day or two, run a rapid course, and, either with or without treatment, are well in a few days.

The difficulty in diagnosis is made much greater by the fact that it is especially in syphilitics that aphthous spots are liable to develop. Fournier describes a recurrent herpes which attacks the oral mucous membrane of syphilitics, producing small erosions which exactly resemble mucous patches. This eruption develops some years after a methodical course of treatment has apparently eradicated the syphilitic taint. Specific treatment is absolutely without effect, the erosions disappearing spontaneously in a few days and recurring at irregular intervals.

In making a differential diagnosis between the erosive and diphtheroid forms of mucous patches, aphthæ, and herpetic lesions, the history of the case, the presence of other signs of syphilis, and the effect of constitutional treatment would all lead to a correct decision.

The *scaly patches* (mucous psoriasis, opaline plaques) must be distinguished from non-specific *leucoplakia* (hyperkeratosis). The latter sometimes develops acutely, particularly in women and children. The lesions change in form and distribution with such rapidity that there is little danger of considering the disease specific.

The chronic form of leucoplakia may be so closely simulated by the syphilitic lesion that a differential diagnosis will be a matter of great difficulty.

The idiopathic leucoplakia—*i.e.*, that of non-syphilitic drinkers and smokers—is even slower in development than the specific lesion; the white color and the heaping up of epithelial cells are more marked and irregular; there is not the same tendency towards central exfoliation, as the lesion extends peripherally,—hence the resultant ring-like configuration is less common. In leucoplakia the lesions are more often found on the tongue and the lower lip, subjective sensations are said to be more marked, and specific treatment is absolutely without avail in effecting a cure.

The points of difference by which ulcerating gummatous lesions of the mucous membrane can be distinguished from the tubercular and malignant infiltrations will be considered when discussing the subject of gummata in special regions.

Treatment.—The treatment of mucous syphilides is constitutional and local, topical applications being much more distinctly indicated than is the case with skin lesions, except when the latter assume the form of mucous patches.

Syphilis of the Tongue.—Chancre is rare upon the tongue, but when present is usually at or near the tip of this organ. (Du Castel.) It is of the erosive type, and presents no peculiarities of development.

Roseola is rare and ephemeral. It appears in the form of slight desquamative stains.

Mucous patches are of the erosive, diphtheroid, and vegetating type; the last variety is rare. When mucous patches are numerous and confluent there is general swelling of the tongue, the latter showing on its borders the imprint of the teeth. Mucous patches placed along the sides of the tongue—a favorite seat—often exhibit more or less fissuring, in which case they may be accompanied by much pain.

The ulcerations of secondary syphilis are usually small and superficial, and are attended with few subjective symptoms; even should they become deep, inflammatory symptoms are not marked.

Smooth patches (Fournier) are not very perceptible till the tongue is dried by a towel or some absorbing fabric. They then appear as smooth, shining surfaces from which the epithelium has entirely disappeared. There is no sign of erosion. The lesions are circular in form, and are grouped in circles or segments of circles.

This form of desquamating glossitis is found in both the secondary and the tertiary period of syphilis. It at times precedes the formation of syphilitic leucoplakia.

Scaly patches (syphilitic leucoplakia) are hardly ever seen except on the tongues of habitual smokers and drinkers. They exhibit the gray-white, circular, circinate, or annular stains already described, and occasion no symptoms unless extensive, when they may be associated with some stiffness of the tongue interfering with articulation; there may also be tingling and a feeling of numbness. The importance of these lesions lies in the fact that they are prone to become cancerous.

The strictly tertiary lesions of the tongue may appear either in the form of a diffuse gummatous infiltration (sclerous glossitis) or as circumscribed gummata. These gummatous lesions develop on the tongue more frequently than in any other portion of the mouth. They are much more commonly observed in men than in women, probably because of the chronic irritation produced by the use of tobacco and alcohol.

DIFFUSE GUMMATOUS INFILTRATION, OF SYPHILITIC SCLEROUS GLOSSITIS, is really a form of chronic myositis. It may be either superficial or deep, and may involve part of the tongue or the whole organ.

The affection begins as a slowly progressive, hard swelling, usually involving but one side of the tongue, and producing marked asymmetry. When both sides are enlarged there may be so much swelling that the patient will not be able to close his mouth. This condition develops with comparatively slight symptoms. There is no pain, the patient complaining only of a feeling of weight and stiffness, making articulation somewhat labored. After weeks, or perhaps months, the swelling gradually subsides coincidently with the occurrence of atrophic changes, which produce even greater stiffening and induration than were present in the early stages of the affection.

Examination of the surface of the tongue then shows irregular lobulations, with marked alteration of the mucous membrane. There are often smooth, red patches, due to exfoliation of epithelium, or areas of greatly thickened epithelium, which may present the typical white appearance of syphilitic leucoplakia.

From mechanical irritation by the teeth, cracks, erosions, and ulcers are often formed.

CIRCUMSCRIBED GUMMA, OF GUMMATOUS GLOSSITIS, may be superficial or deep,—that is, it may involve the mucous or the submucous tissues, or may start in the substance of the muscles.

The *superficial gummata* appear as small, round, hard nodules of the mucous membrane or submucous connective tissue. They vary in size from that of a grape-seed to that of a cherry. They occasion little or no pain, and if not treated by internal medication usually soften and ulcerate, forming punched-out, indurated, undermined, unhealthy ulcers.

When these gummatous ulcers are multiple and confluent, and particularly when they are phagedenic in type, they may destroy the greater part of the tongue, and may threaten life from backward extension of the inflammation and sudden œdema of the glottis.

The *deep* or *muscular gummata* begin as hard, painless tumors, firmly adherent to the surrounding tissues. They are nearly always placed on the dorsum of the tongue. They occasion little or no pain, causing inconvenience only from the limitation of motion. They grow slowly, usually not softening and ulcerating for two or three months. They vary in size from that of a cherry to that of a lemon. When they finally ulcerate, deep, punched-out, indolent, indurated ulcers are found.

The ulcerating gummata of the tongue, even though deep and confluent, excite little pain except on motion, and, indeed, all the symptoms of acute inflammation are absent. On the healing of the ulceration there results a scar, which may be both disabling and deforming.

Diagnosis.—The diagnosis of syphilitic affections of the tongue is made upon the general principles discussed when treating of syphilis of the mucous membranes.

It is particularly on the tongue that the lesions of recurrent herpes are manifested, and it is here that they are most frequently taken for mucous patches or other lesions of active syphilis.

Among other affections simulating syphilis of the tongue, such as ichthyosis and superficial glossitis, is a disease of infancy variously characterized as erratic rash, circinated herpes, or geographical annulus migrans. The tongue becomes covered with concentric rings formed by small, red patches. The senses of taste and touch are normal; sometimes, however, they may be slightly hyperacute. This disease may easily be mistaken for mucous patches or for congenital syphilis.

Ulcerating gummata of the tongue may readily be confounded with tubercular or cancerous lesions.

Tubercular lesions are usually single, and are seated at or near the tip or on the dorsal surface of the organ. They begin as cracks or fissures, attended by swelling, and slowly form shallow, jagged, painful ulcerations, with non-indurated borders, which are often surrounded by minute, pale-yellow points with opaque centres. These are tubercular granulations undergoing caseous degeneration. They are frequently thrown off by ulceration, and are never seen in syphilis. Tubercular glossitis rarely appears as an isolated symptom of the diathesis, the larynx, lungs, or other organs generally showing involvement. The tubercle bacillus may be found on microscopic examination, or may be cultivated by inoculation of guinea-pigs. The lesion is slow in its course, and is not favorably influenced by specific treatment.

The gumma begins as a single submucous or muscular mass, opening after a time by a narrow passage, ulcerating and discharging like a furuncle, having a sloughing indurated base.

Carcinoma is generally found at the borders of the tongue, as a consequence of long-standing irritation. It begins as an erosion or ulcer, which subsequently becomes indurated, may show about its borders epithelial pegs, is shortly followed by glandular involvement, is steadily progressive and somewhat rapid in its course, and is frequently very painful. The diagnosis may be obscured, indeed rendered impossible, by the fact that carcinoma and gumma may develop side by side.

The points of difference between carcinoma and ulcerating gumma are embodied in the following table (Fournier).

Epithelioma.	*Gumma.*
Period of Occurrence.—Chiefly after the fiftieth year.	*Period of Occurrence.*—Earlier in life.
History.—Often cancerous, and preceded by lingual psoriasis.	*History.*—Not cancerous. Not preceded by lingual psoriasis.
Location.—Often on the lateral and under surface of the tongue; unilateral.	*Location.*—Always on the dorsal surface; may be bilateral.
Number.—Single.	*Number.*—May be multiple.
Beginning.—An irregular, indurated, superficial ulceration, which extends rapidly. Marked induration follows ulceration.	*Beginning.*—A thick, rounded induration, opening like a furuncle, and leaving a deep hollow ulcer. Marked induration precedes ulceration.
Appearance.—Elevated, irregular, everted borders; ulcerating surfaces bleeding rapidly on mechanical interference. No cavity resembling abscess.	*Appearance.*—Punched-out, sharply defined edges; sloughing surface, not easily excited to bleeding. Excavation like an abscess-cavity.
Discharge.—Profuse, offensive, irritating.	*Discharge.*—Moderate, not very offensive.
Symptoms.—Lancinating pain often darting towards the ear; great functional disturbance (deglutition, mastication, speech, etc.). General cachexia.	*Symptoms.*—Nearly painless; only slight functional disturbance. No cachexia.
Lymphatic Involvement.—Submaxillary lymphatic glands progressively enlarged and densely indurated.	*Lymphatic Involvement.*—None, or slight swelling and tenderness.

Epithelioma.	*Gumma.*
Therapeutic Test.—Specific treatment useless or harmful.	*Therapeutic Test.*—Specific treatment curative.
Microscopic Examination.—Pearly bodies.	*Microscopic Examination.*—Embryonal cells in various stages of granular degeneration.

Syphilis of the Gums.—Aside from the pyorrhœa induced by medication, and arising from deranged digestion and secondary lesions in the mouth, occasionally there is noted in tertiary syphilis a distinct pyorrhœa alveolaris, signifying syphilitic disease of the bone. This, unlike the pyorrhœa of medication, is cured by rapidly pushing the treatment.

Syphilis of the Palate.—The soft palate, uvula, and half-arches usually show the diffuse or macular erythema of the early secondary specific anginas; mucous patches are also frequently found attacking these structures.

GUMMATA OF THE HARD PALATE usually begin in the periosteum, and are found in or near the middle line forming elevated, sometimes painful, usually multiple, elastic swellings, which shortly soften and ulcerate, exposing the bone, resulting in necrosis of the latter and in direct communication between the cavities of the nose and the mouth.

When these gummata begin on the oral surface of the palate they usually can be detected in time to prevent perforation.

When, as is more commonly the case, they develop on the nasal side of the palate, there is often no suspicion of trouble till a dusky, œdematous, circumscribed swelling appears on the roof of the mouth, which in a very few days shows an opening into the cavity of the nose. This opening represents the small end of a funnel-shaped ulcer, which on examination from the nasal side of the palate may be found to be of considerable size.

The gummata may be multiple, and by confluence may produce large openings in both the hard and the soft palate. They sometimes develop very rapidly, destroying the uvula and the greater part of the soft palate in a few days. When these ulcerating gummata heal there may result great cicatricial deformity, and perforations which can be closed only by plastic operation.

GUMMATA OF THE SOFT PALATE develop slowly, without pain or discomfort on the part of the patient. There may be a general nodular infiltration, or but a single gumma at one point. Ordinarily there is a diffuse infiltrate, which can be distinctly felt on palpation. If this primarily involves the pharyngeal wall of the palate, the only appreciable symptoms will be stiffness and immobility, which are diagnostic signs of considerable value. These signs can be elicited by exposing the pharynx while the throat is being examined and instructing the patient to utter some sounds requiring the assistance of the soft palate for their production. When immobility is thus detected and is found to be associated with nodular induration, the diagnosis of gumma can be made at once. If the anterior wall is involved, the dark red, œdematous, sometimes nodular mucous membrane will suggest the nature of the affection. This diffuse infiltration is prone to ulcerate, destroying a part or the whole of the palate and uvula. The inflammatory process is not limited to the soft palate, often extending to the anterior and posterior half-arches. The cicatricial processes following ulceration may produce great deformity. The soft palate may be partly or totally wanting, or may be adherent to the posterior pharyngeal wall, partly or completely separating the naso-pharynx from the pharynx; though not adherent, it may be stretched tightly across the naso-pharynx, having entirely lost its suppleness and mobility.

Circumscribed gummata of the soft palate may be single or multiple; they are commonly placed on the oral surface. They usually ulcerate if untreated, often causing perforation. Mauriac has called attention to the fact that gummatous ulceration involving the velum, the tonsil, the half-arches, and the lateral wall of the pharynx, and opening up the Eustachian tube, often begins in the recess formed by the juncture of the anterior and posterior half-arches and the upper surface of the tonsil. This ulceration may be extensive and rapid, spreading wide of the tonsil and palato-pharyngeal fold and even eroding the carotid artery.

Syphilis of the Pharynx.—GUMMATA OF THE PHARYNX may be submucous or subperiosteal. They usually appear as one or more hard, painless swellings of the posterior wall. Softening and ulceration follow, resulting in deep, punched-out, indurated ulcers. When gummatous ulceration involves both the soft palate and the pharynx, adhesions may take place in the process of healing, which entirely shut off the nasal cavity from the mouth; or by involvement of the half-arches and tonsils the pharyngeal communications between the mouth and the larynx may be greatly narrowed.

The late ulcerating lesions of the soft palate and the pharynx are often accompanied during their evolution by pain, disability, and interference with hearing, and may be followed by intractable catarrh of the naso-pharynx incident to the deformity following cicatrization.

As a result of this cicatricial contraction the voice may be markedly altered; deglutition may be difficult; or the isthmus of the fauces may be so narrowed that there will be marked obstruction to the entrance of air. Such cicatrices are almost pathognomonic of syphilitic ulceration.

Gummata of the pharynx are generally associated with tertiary infiltrations of the nasal or the oral mucous membrane. The throat often presents an irregularly ulcerated appearance, and exceptionally extremely chronic, distinct, punched-out, typical gummatous ulcers develop, which, if untreated, may extend to the underlying bone.

THE TONSILS.—Gummata are very rarely observed upon the lips or cheeks, and are comparatively rare upon the tonsils.

The ulcerating lesion commonly observed on the tonsil and often considered gummatous is in reality a vegetating papule, which ulcerates, spreads somewhat rapidly, and may assume a diphtheroid or even a phagedenic type. The ulceration is much more superficial than is that of gumma.

GUMMATOUS TONSILLITIS is characterized by painless, hard enlargement, with little functional disturbance, except perhaps some interference with hearing. The mucous membrane, at first stretched tightly over the swelling, becomes somewhat less tense as softening takes place, and finally ruptures. Then result one or more punched-out ulcers with indurated borders and gray sloughing surfaces. These may become confluent, involving the anterior half-arches, and may produce marked deformity when healing takes place. Cicatricial contractions resulting from these gummata may cause permanent closure of the Eustachian tube and interference with hearing.

Subperiosteal gummata, resulting in caries and necrosis, are most frequently observed on the hard palate, the alveolar border of the upper jaw at the insertion of the incisor teeth, and the posterior wall of the pharynx.

The Œsophagus, Stomach, and Intestines.—It is apparent from a few reported cases and from many autopsies that gummatous ulceration may occur in any portion of the alimentary canal. It seems probable, also, that the mucous membrane of this tract is subject to specific general or local inflammation during the secondary period of the disease. Thus the symptoms of catarrhal gastritis or gastroenteritis which are so frequently associated with syphilitic fever or are observed before or during the outbreak of the first erythema may be due to the direct effect of syphilis upon the stomach and bowels. The chronic gastritis often associated with specific lesions of the liver or spleen may also represent a specific infiltration, since it is favorably influenced by specific treatment.

THE ŒSOPHAGUS.—The superficial lesions of early syphilis have not been recognized in the œsophagus. Deep ulceration extending from the pharynx is followed by stricture. Infiltrating gummata developing in the submucous connective tissue commonly ulcerate, eventually forming incurable strictures. The diagnosis during either the ulcerating or the cicatrizing stage of the lesion is dependent absolutely on the finding of associated signs of syphilis, in the absence of other etiological factors, and on the effect of vigorous constitutional treatment. This, if pushed in the ulcerating or early contracting stage, should produce rapid improvement in the symptoms of œsophageal narrowing.

THE STOMACH.—In addition to the symptoms of acute and chronic catarrh, those of gastric ulcer are sometimes noted. This, even though occurring in a syphilitic, may be non-specific in nature, or it may be due to the breaking down of a gumma. In the latter case it is likely to be located near the lesser curvature in the pyloric region. The symptoms of gastric ulcer of syphilitic origin do not differ from those of the non-specific ulcer. The diagnosis must be founded on a therapeutic test, though at least two reported cases seem to show that when the lesion is due to syphilis the pain is greatest at night.

THE INTESTINES.—Except the beneficial results of specific treatment, there is no feature of acute or chronic syphilitic enteritis to distinguish it from non-specific catarrh.

Ulceration of the small intestine may be due to the breaking down either of a gumma or of the lymph-glands of the intestinal wall. According to Rieder's researches, ulceration of the bowel is most frequent in the upper portion of the small intestine. The ulcers are multiple and grouped, exhibit the characteristic infiltration of gummatous ulcers, and are late tertiary manifestations. They involve all the coats of the bowel. They may result in cicatricial stenosis.

These lesions offer no clinical features peculiar to themselves. Their nature can be suspected only from associated symptoms of syphilis.

The Rectum and Anus.—About the anal aperture, especially in women, mucous patches frequently form. These, from maceration and from the irritation incident to defecation, are prone to ulcerate, forming rhagades and fissures, which, by extending in depth, may involve the tissues of the ischio-rectal space, forming deep ulcers or resulting in fistulæ. It is important to bear in mind that such lesions may occur in the secondary stage of syphilis.

Gummata may develop on or beneath the mucous membrane of the anus and rectum, or in the surrounding tissue of the ischio-rectal fossa. Not infrequently they assume the form of a diffuse infiltration, producing rigidity of the walls of the bowel, the mucous membrane remaining quite healthy. This may be followed, if untreated, by ulceration or interstitial absorption, in either case resulting in stricture.

Gummatous ulceration of the mucous membrane usually begins just about the internal sphincter, appearing first as one or many small nodules, which soften and break down, exhibiting dark gelatinous cores. They finally destroy the overlying mucous membrane, forming ulcers, which become confluent, extend in area and depth, and are generally accompanied by inflammatory infiltration of the muscular coat of the gut, including the sphincter, thus producing a narrowing and rigidity distinctly perceptible to the examining finger.

The ulceration frequently extends upward, other gummata forming and ulcerating. From the surface and border of these ulcers there may be an exuberant growth of granulations, producing fungous masses, which may simulate those of malignant disease.

Healing is accompanied by the formation of scar-tissue, which in its subsequent contraction often produces tight strictures.

The perirectal gummata form tumors which may reach considerable size before involving and breaking through the mucous membrane. As a result of the entrance of the bowel contents into the cavities of these gummata, ischio-rectal abscesses are formed, terminating in fistulæ. These fistulæ may be vesico-vaginal, are often multiple, and in some cases riddle the entire perineum, even opening on the surface of the thighs.

The strictures resulting from cicatrization of recto-anal ulceration are much more frequent in women than in men. They are generally found involving the lowest portion of the rectum, and are often associated with vegetating ulcers.

Symptoms.—The acute or chronic proctitis often accompanying ulceration and gummata of the rectum occasions a muco-purulent discharge, a feeling of fulness in the rectum, and usually moderate tenesmus. When the ulcers become fissured and deep, burning pain, tenesmus, and blood-stained purulent discharge are prominent symptoms. The passage of fæces occasions some suffering, and is usually followed by bleeding. When stricture-formation is fairly well advanced there will be constipation alternating with diarrhœa and the passage of ribbon-shaped or broken stools.

The *prognosis* must be guarded. Even if active specific treatment cures the palpable lesions, there sometimes follows fæcal incontinence, from atrophy of the sphincter consequent on interstitial myositis. Ulcers about the rectum are always extremely slow to heal.

Diagnosis.—The lesions of syphilis must be distinguished from those of tuberculosis or cancer.

The tubercular ulcer is found in persons exhibiting other undoubted lesions of tuberculosis.

Cancer almost exactly simulates infiltrating and ulcerating gummata. It is more prone early to contract tight adhesions to neighboring parts, and is usually placed higher up the bowel than gumma. Excision and examination of a portion of the growth would establish its pathology.

Treatment.—In addition to general specific medication, the ulcerating surfaces must be treated carefully. When ulcerations are slight and superficial, regulation of the bowels and cleansing injections repeated night and morning may be sufficient. Deep ulcers may require stretching of the sphincter followed by many weeks of rest in bed, with daily topical applications suited to the condition of the granulating surface. Strictures can be benefited only by dilatation or operation.

CHAPTER XXV.

SYPHILIS OF THE NERVOUS SYSTEM.—OF THE EYE.—OF THE EAR.—OF THE RESPIRATORY TRACT.

Cerebral Syphilis.—There is no nervous symptom caused by syphilis which may not be exactly paralleled by a symptom found in a cerebropathy from another cause; in other words, there are no symptoms pathognomonic of the disease. Caries of the bones of the skull, indirectly implicating the brain, produces the same symptoms whether the caries be tubercular, traumatic, or syphilitic, and pachymeningitis, endarteritis, and cerebral growths cause similar symptoms regardless of their etiology.

Etiology.—A nervous temperament seems to predispose to the development of brain-lesions, though from this it must not be understood that brain-workers are more prone to suffer from this form of the disease than are others. The conditions which certainly predispose to the development of brain-symptoms during the course of syphilis are absence of a sufficiently long and thorough course of specific treatment during the secondary and the early tertiary period of the disease, alcoholism, or hereditary neurosis. The rheumatic diathesis, traumatism, prolonged worry or anxiety, and exposure to heat are also held to favor the same result.

In the large majority of cases in which syphilis attacks the nervous system, it does so in the absence of any obviously sufficient cause, and "simply," as Mauriac says, "because, forsooth, it pleases it to do so."

Mauriac and Broadbent among others have observed that in cases of cerebral syphilis the primary lesion and the early manifestations are more than likely to have been quite insignificant; no positive conclusion, however, can be based upon this observation, because no one would maintain the truth of its converse,—viz., that because the secondary lesions or manifestations were severe, no invasion of the nervous system would follow. The probable reason why syphilis attacks the nervous system after a light secondary stage is that, on account of its mildness, a sufficiently vigorous and prolonged mercurial treatment was not enforced. Violent nervous disturbances occurring at the time of the secondary eruption and disappearing with it do not necessarily indicate a future determination of the disease to the brain or the spinal cord; but if these disturbances increase after the disappearance of the cutaneous eruption, or if after disappearing they reappear, the prognosis as regards cerebropathies must be guarded.

Time of Appearance.—Cerebral syphilomata are the most precocious of all the tertiary manifestations; the nervous centres may be attacked at any period of the disease after the beginning of the secondary stage. The average time, however, for their appearance is in the third and fourth years after infection, but they may manifest themselves even as late as eighteen years after the infecting chancre. Later than this they are of greater rarity.

Pathology.—Brain-lesions of syphilis may appear as areas of sclerosis or of softening and atrophy, or gummata may develop. In either case the pathology is the same. There are cellular proliferation and formation of vascularized granulation-tissue, usually diffuse in the case of the central nervous system and its meninges, and ultimately resulting in atrophy and sclerosis. Exceptionally cellular proliferation is circumscribed and extensive, forming gumma. Associated with these changes, or developing independently of them, syphilitic arteritis is a prime factor in the causation of brain- and cord-lesions.

Gummata are formed with far less frequency in the cerebral tissue proper than in the bones of the skull, or in the meninges or the subarachnoid space. When they form, however, they assume the same general appearance as elsewhere. They are seldom smaller than a pea or larger than an egg, are very consistent, with a caseous dry core, and are surrounded by highly vascular cerebral tissue containing numerous embryonal connective-tissue cells.

Gummata are commonly found in groups of three or four; they may be single or multiple. Although they may be found throughout the brain, they usually grow from the dura mater or the subarachnoid space at the base of the cerebral hemispheres near the pituitary body, or on the convexity about the frontal convolutions.

It is at times extremely difficult to distinguish a large tubercle of the brain from gumma. The symptoms will be the same. An autopsy shows the tubercle as a somewhat regular and sharply defined tumor, with no extensions into the surrounding tissue, frequently exhibiting miliary tubercles about the periphery, and at times having undergone almost complete caseous degeneration. These are characteristics never observed in gummata. The vessels in the tubercular mass are obliterated; in large gummata the vessels, even to the centre, are pervious. Tubercle is found far more frequently in the young, and is usually associated with miliary deposits elsewhere in the body. Nowhere else, however, have these two lesions such similarity as in the brain.

Gumma-formation in the brain is not a rapid process; it increases slowly up to a certain point, and then remains a long time stationary unless by its size the gumma occludes blood-vessels and thereupon sets up a passive hyperæmia or ischæmia with consequent softening, which is the natural tendency of all such neoplasms. Under antisyphilitic treatment, however, gummata may be apparently absorbed, or at least checked, and then, not infrequently, a post-mortem discloses on the surface of the brain characteristic cicatrices or depressions, which are the remains of the pre-existing gummata, of which the patient had been apparently cured for many years.

Intracranial syphilitic processes never involve the entire tissue wherein they are situated, but are apt to develop from several foci situated on any of the intracranial tissues. They seldom attain a large size, and even the pseudo-membranous patches of the dura mater, which are more diffuse or extensive than gummata, never cover completely the surfaces of the membrane over the hemispheres, wherein they differ from the ordinary congestive and inflammatory processes.

Syphilitic processes in general are far more frequently found on the surface of the brain and on the meninges than deep in the cerebral substance. Their most frequent seat is on the frontal portions and on the base of the brain in the sphenoidal region.

In addition to the gummatous and sclerotic lesions, which are the direct product of syphilis, there are lesions dependent on inflammatory or ischæmic processes,—the sequelæ of syphilitic endarteritis. This endarteritis brings about a narrowing of the calibre of the vessels, producing a lessened blood-supply and consequent interference with function. As this narrowing increases, thrombosis may occur, with complete obliteration, in consequence of which, if the vessel affected is a terminal artery, the portion of the brain supplied by this vessel degenerates. When the basilar arteries are involved, the free collateral circulation prevents any symptom, even though the process has advanced to the formation of thrombosis. From this clot, however, an embolus may be loosened, which will produce the same symptoms as a cerebral embolism occurring in the course of any other disease.

The degeneration of the arteries, whether caused by syphilis direct or by the proximity of syphilitic lesions, is perhaps the most important factor in the cerebropathies of syphilis, particularly in regard to softening and hemorrhages. When syphilis attacks the bones of the skull there may be cerebral symptoms, caused either by an actual infection of the brain or by a mechanical compression arising from a gummatous formation or by the presence of pus between the bones of the skull and the dura mater. It is rare that the brain-substance at the point of osseous lesion is not affected.

Of the envelopes of the brain the dura mater is the most frequent seat of syphilitic lesions, not only because they are prone primarily to develop here, but also because the osseous lesions implicate this membrane.

In the patches of chronic syphilitic pachymeningitis there is little to characterize as specific; in all respects they resemble patches of pachymeningitis produced by any other cause. When situated on the upper surface of the membrane these sclerotic patches can involve large areas without giving rise to appreciable symptoms, but when situated in the membrane surrounding the canals of exit of the nerves they become highly dangerous.

Gummata of the dura mater may occur on either surface of that membrane, and are round in shape, of firm consistence, sometimes a little soft, almost never liquid. One or more may be present, from the size of a millet-seed to that of an egg; they are grayish in color, with a firm centre. The adjoining nerves are atrophied, and the arteries may be not only obstructed by compression but invaded by the gummatous material, or even obliterated. Obliteration of the carotid, middle meningeal, and basilar arteries has been noted. In a case of gumma of the tentorium cerebelli all the sinuses bordering on the torcular Herophili were obliterated (Dowes).

Syphilomata of the arachnoid are rare, and appear as opalescent spots more or less thickened. They are either diffuse or grouped in compact masses in the centres of which are gray degenerations. True gummata are very rarely found.

The pia mater is the cranial tissue wherein the development of syphilitic meningitis is by far the most frequent.

From this membrane the greater part of the sclerotic and gummatous changes start, subsequently invading the other portions of the encephalon. The lesions are more often of a fibro-cellular character than gummatous, and assume the form of plates or bands, following the course of vessels, most frequently along the edge of the fissure of Sylvius. They consist merely of opalescent patches, with a slight thickening of the membranes. Their tendency to extend along the vessels or nerves often produces symptoms of circumscribed ischæmia and cerebral malnutrition, as well as neuralgias and paralyses of certain nerves. The motor nerves of the eye and the fifth pair are most liable to be thus affected.

The post-mortem appearance of these lesions shows a close union of the membranes of the brain, with perhaps a slight adhesion to the cerebral cortex. True gummata in the pia mater are not quite so common as in the dura; they may attain large size. They are most frequently found in the frontal regions and at the base of the brain near the sella turcica. Small gummatous nodules also form along the arteries, and impinge not only on the brain but on the arteries themselves, at first obstructing their lumina and afterwards obliterating them, thus producing ischæmia of the brain.

The nerves of the membrane may likewise suffer and become atrophied by compression.

The arteries of the brain are always more or less implicated, either primarily or consecutively.

When they are themselves the seats of syphilitic degeneration they influence the nervous system directly by means of aneurismal dilatation or by hemorrhages which press upon the brain-substance. Indirectly, syphilis of the arteries can affect the brain by narrowing the lumen of the vessels and by destroying their elasticity, thus cutting off the blood-supply; all the symptoms of cerebral ischæmia thereupon follow. A thorough post-mortem microscopical examination is sometimes required to reveal the numerous miliary aneurisms along the smaller arteries and capillaries or the obliteration of these vessels. Syphilis, then, may attack the brain in the form of:

1. Diffuse gummatous infiltration of the meninges, with extension to the brain-substance.
2. Gummata, or circumscribed tumors.
3. Endarteritis, with its concomitant brain-lesions.

Symptomatology.—An examination of the symptoms of syphilis of the cerebrum and of its envelopes must include all known symptoms. But, while there exists no one pathognomonic sign to serve as a guide, there are, nevertheless, groups of symptoms, subjective or objective, which are fairly distinctive.

In general, syphilitic neuroses are characterized by multiplicity and incoördination of symptoms of either gradual or rapid development.

Except headache, disturbances of sensation, whether neuralgias or anæsthesias, are not commonly due to syphilis when they predominate over the other symptoms. On the other hand, disturbances of motility are frequent. Cerebral syphilis will inevitably, sooner or later, if left to itself, develop a paralysis or paresis. The neurosis may be at first revealed by epileptiform convulsions, but eventually paresis sets in, together with other symptoms of cerebral softening, rapid loss of memory, and weakened cerebration.

As a prodromal symptom headache is chiefly characteristic. This varies greatly in intensity. It is worse at night, and is usually constant, is deep-seated and extremely harassing, and is accompanied by a certain failure in mental power, a lack of ability to concentrate the attention, and a condition of nervousness characterized by foreboding and a marked excitement from trifling causes. There are often vertigo, insomnia, and profound mental depression.

When the syphilitic process is circumscribed, as in the case of a gumma or of an aneurism due to syphilitic arteritis, the pain is restricted to a limited area, and is described as like that of a nail being driven into the head. When patches of sclerosis are extensive, the cephalalgia may cover all one side of the head.

Fournier has described this symptom and its indications as follows: Pain in the head is one of the most frequent manifestations of secondary syphilis. The prodromal headache of tertiary encephalopathies is universally recognized. It is unfortunate that the term specific cephalalgia conveys the impression of a single pathological process, when, as a matter of clinical fact, the lesions are often widely diverse in their nature. The single symptom common to all is pain in the head.

Aside from syphilitic affections of the brain and its meninges, the true specific encephalalgias, the pain may be due to the specific poison affecting one or more of the cranial nerves, constituting what may be called neuralgic headache. Or it may be due to lesions of the cranial bones, such as periostosis or gummatous osteoma, causing bone pain. Or it may develop as bone neuralgia without demonstrable lesion, in which case it is often impossible to locate it. In many respects it does not differ from headaches due to causes other than syphilis. Finally, there is a headache which, though dependent on syphilis, is not syphilitic in nature; in other words, it is a parasyphilitic neurosis.

SYPHILITIC NEURALGIAS are not headaches in the true sense of the word; the pain is located in the trunk or branches of distribution of a given nerve, and is aggravated by pressure along the course of this nerve, particularly at its point of emergence from the bone. This pain most frequently attacks the fifth pair, and has for its type supraorbital neuralgia. It is observed during the early stage of the secondary period,—that is, in the first six or eight months of the disease. It is impossible to state whether or not it is dependent upon organic lesion. When it occurs during the tertiary period it is nearly always due to a distinct infiltration; sometimes it is caused by the pressure of a gumma or bony outgrowth. These specific neuralgias exhibit almost the same symptoms that distinguish neuritis from other causes. They have, however, a tendency to become worse at night, and yield promptly to specific treatment. Indeed, the therapeutic test is the only means of making a positive diagnosis.

HEADACHE FROM BONE-LESIONS.—Pain due to bone-involvement may occur in the early stages, during the height of the disease, or at a late tertiary period. It is most frequent in the tertiary period, and is then readily recognized, since the lesions are gross, producing considerable deformity.

Secondary lesions are slight, circumscribed, and readily overlooked, especially when they develop in the hairy scalp. They occur during this early period as periostitis, periostosis, or ostealgia characterized by circumscribed areas of hyperæsthesia without appreciable infiltration. These lesions are very common, especially in women.

.The periostites produce slight circumscribed swelling of the bone, particularly in the parietal, temporal, and frontal regions. The involved areas are small,—about the size of a ten-cent piece, sometimes as large as a fifty-cent piece,—very slightly raised, sometimes obscurely fluctuating. They are painful and extremely sensitive. This excessive sensibility is a characteristic sign.

Periostoses give the same symptoms, and are even more painful. They are, however, more dense and resistant and last longer. There is true bony proliferation.

The ostealgias are characterized solely by pain and tenderness. There is neither swelling nor appreciable alteration of any kind. The pathological basis of this symptom is absolutely unknown. The pain is sometimes agonizing, and often radiates over a large surface. The diagnosis is founded upon careful and thorough palpation of the entire cranium.

HEADACHES DUE TO SYPHILITIC AFFECTIONS OF THE BRAIN OR ITS ENVELOPES are more diffuse and more deeply placed than those dependent upon bony lesions or upôn neuralgias. It is impossible from the symptoms to decide whether they are caused by lesions of the meninges, of the cerebrum, or of the blood-vessels, or whether all these structures are involved.

Clinically, three varieties are recognized: 1, secondary encephalalgia; 2, headache symptomatic of cephalic lesions; 3, parasyphilitic headache, due to hysteria or neurasthenia.

SECONDARY SYPHILITIC HEADACHE, which develops during the early periods of this stage of the disease, is very common, especially in women; indeed, in them when untreated it is usually severe and prolonged. The pain is felt within the head. It is general, but especially severe in the regions of the forehead, the temples, and the occiput. The pain may be described as a feeling of weight in the head, or a beating, or a sense of pressure; sometimes it is lancinating or tearing, as if the cranium were about to burst. The pain varies greatly in intensity; it may be slight, bearable, not interfering with the pursuits of life; or as severe as an ordinary migraine, preventing work, particularly that requiring much thought, and disturbing sleep; or agonizing and absolutely unbearable.

Associated with the headache there are usually diminution of appetite, disordered digestion, general malaise, nervous erethism, great excitability, and sometimes disturbance of vision, with vertigo. The patient becomes morose, melancholic, stupid, and forgetful.

These headaches may assume the intermittent type or the continuous type with exacerbations. The intermittent type is most frequent, especially in the slight forms and those of medium severity. The pain usually comes on at about five or six o'clock in the evening and disappears during the night, often recurring at the same hour and in the same form day after day and following the same course.

The continuous type with exacerbations is less frequent. In these cases the headache never disappears entirely; but here again the exacerbation is observed in the evening or during the night.

In some cases these secondary headaches disappear in a few days or one or two weeks. Usually they persist for several weeks, or even for several months.

Diagnosis.—The diagnosis is founded on the nocturnal exacerbations and the prompt, characteristic, and extraordinarily curative effect of specific treatment. Night exacerbations of cephalalgia are not confined to syphilis. From the symptoms alone these headaches cannot be distinguished from those of anæmia, of hysteria, or of rheumatism. Fortunately, syphilitic headache is commonly associated with other incontestable signs of the disease or with a history which is suggestive. Usually there are syphilides or alopecia and articular pains. In the rare cases where both history and concomitant symptoms of syphilis are wanting, an elimination of other causes of cephalalgia would suggest syphilis and consequently specific treatment. Thus, neuralgic cephalalgia would be distinguished by pain referred to certain points along the course of nerves; migraine, by comparatively long periods of remission; rheumatic cephalalgia, by superficial, muscular pain, increased on contraction of muscles, and relieved by heat; anæmic cephalalgia, by the facts that it lessens during the evening, that it is made better by eating, and that it is accompanied by other symptoms of lessened hæmoglobin; neurasthenic cephalalgia, by its less severe pain, its partly diurnal character, and its long continuance.

Treatment.—The specific treatment of secondary cephalalgia is attended by prompt results. Inunctions and full doses of potassium iodide should be given.

PRODROMAL CEPHALALGIA OF TERTIARY LESIONS.—The most important variety of specific migraine is that preceding the grosser symptoms of cerebral syphilis. In certainly two-thirds of all cases of hemiplegia, amnesia, aphasia, epilepsy, coma, pseudo-paralysis, etc., dependent upon syphilis, there is this prodromal headache. A large percentage of these cases could have been saved from these grave accidents by vigorous treatment instituted during the prodromal period.

This headache differs from other cephalalgias, as, for instance, those due to neuralgia or to epicranial rheumatism, in the fact that it is felt to be deep within the head. The character of the pain varies: 1, there may be simply a sense of weight and hebetude; 2, there may be a constrictive pain, as though the head were screwed in a vice; 3, the sensation may resemble that produced by blows of a hammer, the suffering being intense and the pain deeply placed. These three types may be associated or may succeed one another.

The pain may be sharply circumscribed to an area not larger than a half-dollar. In this case it frequently indicates the formation of a gumma. Sometimes it is diffuse, occupying a general region, as the frontal, temporal, parietal, or occipital, or is spread over two or more of these regions. Exceptionally it seems to involve the whole head. The fronto-parietal region is the one to which this pain is most frequently referred. This form of cephalalgia has three characteristics which should at least strongly suggest its nature: 1, there is an habitual intensity, sometimes extraordinary severity, of pain; 2, it is persistent, tenacious, long-lasting; 3, there are nocturnal exacerbations.

Even in mild cases the pain is less bearable than the ordinary headache; it harasses the sufferers, making them despondent, morose, excitable, and sleepless, and interferes with general nutrition; or it may be so severe as completely to prostrate them. Exceptionally the pain amounts to a veritable anguish, comparable in intensity to that of hepatic or nephritic colic.

As a rule, syphilitic cephalalgia precedes the grave developments of brain-syphilis by an interval of from three to six weeks; it is, however, not uncommon for this pain to last from three to six months; exceptionally the pain may exhibit remissions and exacerbations for two or three years. Under the influence of intermittent mild specific treatment the headache may be temporarily cured, to recur time after time, till symptoms such as hemiplegia or epilepsy show that irreparable damage has been done.

Nocturnal exacerbations of pain, though the rule, are by no means invariable. In the secondary period this characteristic is most pronounced; in the tertiary period it may be wanting entirely; indeed, there may even be nocturnal remissions.

The prodromal headache of tertiary syphilis is a sign of inestimable value, enabling treatment to be adopted in time to prevent grave lesions.

Treatment.—The treatment should be instituted early, and should be sufficiently thorough to cure the headache and to eradicate as far as possible the underlying constitutional taint. Mercury and potassium iodide should be given in the most active manner possible. Daily hypodermic injections of corrosive chloride or inunctions of mercury ointment should be given in full doses supplemented by the vapor bath. Internally, potassium iodide should be rapidly pushed to the extreme point of toleration: to a woman, one to one and a half drachms a day; to a man, nearly twice this dose. This treatment should be long continued, with appropriate short intervals of rest, until there is good reason to believe that there is no likelihood of recurrence. Fournier has relieved the agonizing cephalalgia of high tension by lumbar puncture.

PARASYPHILITIC CEPHALALGIA.—Among the parasyphilitic headaches may be mentioned the neuralgic migraine and the crises of pain often observed in tabes. The most important cause of these headaches, and by far the most common, is neurasthenia. This is an ordinary sequel of syphilis, and among its multitudinous symptoms none is more troublesome or more frequent than headache.

This parasyphilitic neurasthenic headache is characterized by moderate intensity; it is not really a pain, but rather a sensation of weight or constriction, of dulled or imperfect cerebral action. It usually lasts several years. It is present in the morning on rising; is sometimes better after meals, but shortly returns with its original intensity, or even with a slight excess of this; it is better at night, so that sleep is not disturbed. It is not benefited by specific treatment; it is usually located in the occipital region; and it is often associated with other signs of neurasthenia. These are characteristics which sufficiently distinguish this cephalalgia from pain preceding the recognized cephalopathies; indeed, a headache which has lasted for several years almost certainly does not belong to the latter class, since apoplexy or some one of the serious symptoms denoting irreparable brain-lesion is certain to develop long before the expiration of this period.

Yet it may well happen that a differential diagnosis cannot be made. In this case the mixed specific treatment should be given one thorough trial. Should it fail, there should be no further effort in the direction of attempting cure by this treatment.

When the diagnosis of parasyphilitic neurasthenia is firmly established, minute attention to general hygiene, thorough hydrotherapy, especially with douches of brief duration, and congenial surroundings, represent the best methods of accomplishing a cure. The only drug which is of the least service, aside from tonics and nutritives, is potassium bromide; this sometimes relieves the headache.

But we cannot affirm that all grave syphilitic cerebropathies are preceded by these headaches. Mauriac quotes a case in which a man aged twenty-two was suddenly seized with severe convulsions of the left arm, which were undoubtedly due to syphilis, but which were preceded by no prodromal headache or other nervous symptoms. Fournier also has noted a similar case wherein the patient had suffered no headache during the ailment, and yet the post-mortem disclosed extensive syphilitic disease of the brain.

Following these prodromal symptoms there are certain symptoms, which Finger classifies as follows:

1. Psychical disturbances, with epilepsy accompanied by paresis not involving the cerebral nerves, terminating in coma. In these cases gummata and wide-spread endarteritis of the convexity of the brain are found.

Following the prodromes or without symptoms there is a sudden, often violent, epileptic attack, sometimes not accompanied by complete loss of consciousness. This is followed by cerebral irritability and fatigue, mental failure, progressing to dementia, localized muscular weakness, paresis or paralysis which may be of irregular distribution, and slow, halting speech.

2. Apoplectic attacks followed by hemiplegia associated with somnolence, with symptoms of irritation of one side and paralysis of the cerebral nerves.

In these cases there are gummatous infiltration of the base and arteritis involving the vessels of the large central ganglia. Following prodromal symptoms there is suddenly developed palsy of one or more cranial nerves, the oculo-motor and abducens being most frequently involved. This will be shown by ptosis, strabismus, loss of accommodation, etc. These palsies are persistent, and may be preceded or accompanied by twitchings or contractions of the muscles supplied by the affected nerves. Following these symptoms, or sometimes preceding them, there is an apoplectic attack, often not attended by loss of consciousness, but with hemiplegia and disturbance of speech. Even when this stage is reached almost complete restoration of mental power is possible. If the disease is progressive, other apoplectic attacks supervene, the mind becomes dull and listless, there are involuntary micturition and defecation, and finally coma and death supervene.

3. Psychoses, appearing generally in the form of paralytic dementia or progressive paralysis.

These psychoses are usually accompanied by paresis or paralysis, especially of the cranial nerves, and by epileptiform attacks.

The syphilitic cerebropathies are most commonly characterized by a slow but steady advance; thus, a slight neuralgia expands into epileptiform convulsions, and finally ends with paresis or paralysis.

Diagnosis of Intracranial Syphilis.—In general it may be affirmed that all non-traumatic, non-cardiac cerebropathies found in persons of previously good health between the ages of twenty and forty are probably of syphilitic origin. If there is a history of preceding chancre the diagnosis is still further assured. Epilepsy, if idiopathic or inherited, always makes its appearance in childhood; when it occurs late in life and is non-traumatic it is exceptional, and is then probably due to syphilis. Paresis, not of toxic or traumatic origin, occurring between the ages of twenty and forty, is due to syphilis in eighty per cent. of cases. In nervous disorders wherein two diatheses are possible causes, for instance, the gouty and the syphilitic, the diagnosis is to a certain extent dependent upon the therapeutic test.

A gouty diathesis is apt to produce nervous symptoms only late in life, but in all other respects gouty and syphilitic cerebropathies may be almost identical. In both gout and syphilis arterio-sclerosis is a common feature, and the same symptoms would follow from whatever cause the lesion was produced.

Even the therapeutic test is not wholly trustworthy in deciding as to the specific nature of palsies. Paralysis of the facial nerve, though strongly suggesting syphilis, is not pathognomonic, since facial paralysis may be produced by cold, and may be only a transitory affection, which disappears under full doses of potassium iodide simply because it has run its course. It is always possible that the paralysis may have been an independent acute attack, and might have disappeared of itself without treatment.

Attention has been called to the fact that the symptoms of cerebral syphilis are often attributed to slight disorders, and hence treatment is not instituted at the time that it is most valuable.

In forming a diagnosis a minute study of the previous history is imperative, as well as careful observation of the entire symptom-complex. The diagnosis will then be founded on a syphilitic history, a prodromal headache persistently worse at night, and often associated with vertigo, impaired mental activity, localized paresis, epileptiform or apoplectiform attacks, not necessarily attended with loss of consciousness, hemiplegia and paralysis particularly involving the cranial nerves, marked psychoses, and coma. These symptoms are somewhat irregular, but progressive. They are checked by specific treatment. Vertigo is of significance only when associated with headache; it is aggravated by excitement or sudden change of posture, and may merge into transient unconsciousness. Insomnia is the rule in patients under fifty, who are often unable to sleep at all during the first part of the night. This insomnia bears a relation to the intensity of the headache, and disappears with the latter on the onset of paralysis. Somnolence is observed in patients over fifty.

The paralysis that develops during sleep is probably due to a thrombus, that which occurs during brain activity is probably caused by rupture. Involvement of the third nerve is so characteristic of intracranial syphilis that ptosis or strabismus developing suddenly in an adult is diagnostic. Epilepsy developing in the adult is traumatic, uræmic, or syphilitic, and hemiplegia, if not apoplectic, is usually of the same nature.

Prognosis.—The prognosis is always grave unless energetic antisyphilitic treatment can be instituted before the syphilitic lesions have produced actual destruction of nerve tissue from pressure incident to involvement of the neuroglia and adventitious tissues. In most cases a guardedly favorable prognosis can be based on a prompt response to specific treatment. Meningitis, gummatous tumors, many cases of myelitis and paralysis due to thromboses or to endarteritis obliterans, offer a prognosis much more favorable than do these same conditions when due to other causes. Locomotor ataxia, which is specific in origin in over seventy per cent. of cases, is sometimes apparently made worse by specific treatment. Syphilitic epilepsy in its earliest stages may be helped by treatment; later, because of habit, the cause becomes of minor importance so far as cure is concerned; moreover these patients are often intolerant of iodides. The prognosis in general paralysis of the insane, even when the cause is distinctly syphilis, is almost invariably hopeless; certainly nothing positive can be promised as to the final outcome.

In a large proportion of the cases of intracranial syphilis, the lesion is an endarteritis obliterans. Before the obstruction is complete, much can be done by active treatment.

Treatment.—The treatment for cerebral syphilis is the same as that for all tertiary lesions,—namely, a mixed treatment of potassium iodide and mercury. The potassium iodide should be started in full doses of thirty to forty grains daily and pushed rapidly to the point of tolerance. Everything depends upon obtaining a prompt action, and to begin with small doses of five or six grains is a dangerous waste of time. The prodromal period is the time to avert irremediable degenerations and to ward off the violent nerve-storms which are sure to follow if the treatment be neglected. Hygienic measures are not to be ignored, the nervous system must be kept at rest, there must be no household or business worries, and there must be, if possible, moderate and regular exercise. Attention to the digestive tract is of the utmost importance.

In convulsive types the bromides are useful; antipyrin, chloral, and chloralamide are at times of greatest service when the pains are intense. Electricity should be employed to exercise and stimulate the paralyzed muscles. When rapid action of the specific is imperative, hypodermic injections of mercury are indicated. Potassium iodide is most conveniently given in the saturated solution of which one minim contains one grain. The mercury may be given hypodermically or by inunction. The limit of physiological toleration to these drugs should be reached early and maintained by full doses.

SYPHILIS OF THE SPINAL CORD.

Syphilis of the spinal cord cannot be said to have in its symptoms the irregularity and incongruity which are the characteristic features of cerebral syphilis. Myelopathies due to syphilis correspond in every respect to those due to other causes. Syphilis, however, is an etiological factor of the greatest frequency in all myelopathies, whether distinguished by softening or by sclerosis, either diffuse or circumscribed: so that it is almost justifiable to assert that any myelopathy of which the cause is not manifest is syphilitic.

The syphilitic lesions which may affect the cord and its membranes are identical with those which affect the brain,—namely, diffuse gummatous infiltration followed by sclerosis, circumscribed gummata, and endarteritis. Myelopathies occur with the greatest frequency during the third or fourth year after infection; cases, however, have been observed occurring as late as twenty-five years after the contraction of syphilis.

Etiology.—There is no satisfactory explanation as to why syphilis should attack the cord in some cases and not in others. In addition to the general causes mentioned when treating of cerebral syphilis, venereal excess and, according to Mauriac, the influence of a damp cold climate should be included.

Morel-Lavallée thinks that there is special virulence in the original infecting germ of certain cases of syphilis which has a predilection for the nervous system. He cites from personal observation the cases of five men who contracted syphilis from the same source, and all of whom died, at varying periods after infection, from syphilitic disease of the nervous system, while, strangely enough, the woman who infected them married and gave birth to a healthy child. This special virulence he calls the "vérole nerveuse."

As a rule, syphilis does not attack primarily the essential tissues of an organ,—as, for instance, the nerve-cells themselves: hence gummata of the cord are excessively rare; they do occur, however, in the centre of the cord, and somewhat more frequently on its surface, adhering closely to the meninges, from which possibly they originate. They present the same appearance as gummata of the cerebrum.

The most common forms of syphilitic myelopathies are sclerosis and softening, which are usually associated and which may be widespread or circumscribed. Softening often, not always, follows in the path of the sclerosis; it is only exceptionally a rapid process, and where symptoms of spinal disorder have existed for a length of time is commonly found in disseminated patches. When the myelopathy has advanced rapidly and deep bed-sores form in the sacral region, the softening is generally extensive, without patches of sclerosis.

Fibrous degeneration or sclerosis of the cord is more frequent than softening, but for the most part the two processes are so intimately associated that they may be considered as but two phases of the same process.

Lesions of the cord consequent upon syphilis of its bony envelope are far less frequent than are the corresponding cerebral lesions; possibly because of the greater space between the vertebræ and the nervous tissue, and also because the vertebræ have a periosteal envelope independent of the dura mater.

The meninges of the cord are especially liable to be attacked. The membranes are so intimately associated that it is almost impossible to distinguish in which of the three the lesion originated, since it always rapidly spreads from one to the other, thus making at the invaded point one thick membrane, possibly studded here and there with gummatous deposits.

Symptomatology.—The symptoms of myelo-syphilis present the same general characteristics as cerebral syphiloses,—namely, dissemination of manifestations, a marked tendency to temporary amelioration, and recurrences, together with early implication of the bladder and rectum.

The development of symptoms due to compression of the cord by a syphilitic osteophyte is usually comparatively slow, but otherwise the same as from compression due to any other cause. When, on the other hand, syphilitic disease of the bone has gone to such an extent as to produce a sudden dislocation of the vertebræ, then symptoms arise as suddenly, and vesical and rectal troubles are among the first.

The paralytic and trophic symptoms vary according to the situation of the compression or degeneration. The cervical region is most frequently attacked, and if the compression is only slight the upper extremities alone will be affected. A point of tenderness can almost always be elicited on the spinal column opposite the lesion of the cord, and in a case of suspected cervical lesion an examination of the throat should always be made; there is a possibility that deep ulcerations may indicate disease of the vertebræ in this region.

SYPHILITIC MENINGITIS is rarely of an acute type; it more commonly assumes the form of sclerotic patches or bands pressing on the cord, and is manifested in much the same manner as compression due to other causes. The dorsal and lumbar pains are of excruciating intensity, made worse by motion. Finally, paralysis of the extremities and sphincters supervenes, and indicates that softening or annular constriction of the cord has commenced.

ACUTE OR SUBACUTE MYELO-SYPHILOSES are not as common as the chronic, and are often found in secondary syphilis. When they occur at a period long after the chancre, with no other manifestation of the disease, the diagnosis is extremely difficult. Vesical troubles and weakness of the lower limbs are usually the first symptoms, which rapidly advance to paralysis and retention of urine and fæces, followed shortly by incontinence and the formation of deep bed-sores on the sacrum and the heels. Fever, if any develops, is slight.

Treatment is of little avail, and death ensues in a few days or weeks. This acute myelo-syphilosis is the most dangerous of the syphilitic affections of the cord.

CHRONIC MYELO-SYPHILOSES are distinguished not so much by their duration as by the gradual development of symptoms. They are much more common than the acute forms, and less likely to have a rapid termination.

The first symptoms are usually overlooked, and consist of neuralgic pains, with weakness in the limbs. Slight difficulties of micturition and gradual enfeeblement of sexual power follow in order. The weakness gradually develops to paresis or paralysis, and the sexual power is entirely lost. The patient next suffers all the excruciating pains and girdle symptoms of myelitis. It is very rare for disturbances of sensation to keep pace with the paralysis. A part of the body entirely paralyzed may still retain its normal sensibility, or else the sensation may be merely blunted and the patient be unable accurately to localize the sensation. The reflexes are at first exaggerated, but soon become much diminished or abolished. Bed-sores are very slow to make their appearance. The symptoms are usually confined to the lower extremities, and it is rare for the process to have a tendency to ascend the cord.

Under the influence of specific treatment the disease may be occasionally checked or even apparently cured; but it must be remembered that temporary ameliorations are characteristic of all syphilitic neuroses.

Tabes Dorsalis.—In all other myelo-syphiloses certain pathological elements can be found—namely, traces of gummatous material—which determine the syphilitic origin of the lesion, but in tabes dorsalis or locomotor ataxia of syphilitics search for a pronounced syphilitic element is vain. It is only from the evidence supplied by numerous statistics showing the association of tabes dorsalis with syphilis that we can infer a connection between the two.

The tabes which attacks syphilitics is identical with that which attacks those who have not the slightest syphilitic taint. Fournier found in two hundred and forty-nine cases of tabes two hundred and thirty-one in which there was undoubted syphilis,—that is, ninety-three per cent. Many others have compiled statistics coinciding for the most part with this percentage.

As syphilitic tabes is similar in symptoms to ordinary tabes, so is it similar in its usual incurability; when it is once firmly established, potassium iodide and mercury often have no effect; on the contrary, they may be rather deleterious.

The diagnosis of tabes is not very difficult when the disease is fully developed, but to be able to recognize it in an incipient stage and find a clue to its etiology is, though most difficult, of the utmost importance. In this early stage, cures under antisyphilitic treatment are possible; this strengthens the theory of its syphilitic connection or origin.

The premonitory symptoms of ataxia may be nothing more than pains in the lower extremities, which are for a considerable time regarded simply as rheumatic; they have not the characteristics of the osteocopic pains. Urinary troubles without apparent cause are also signs of great value, and it is quite common to see associated, in addition to all the symptoms of ordinary tabes, a few other manifestations of an irregular, perhaps cerebral, type. Mario Bertolotti notes that the Argyle Robertson pupil may be indicative of syphilitic meningitis, general paresis, meningomyelitis, and pseudobulbar palsy, and that it is one of the earliest symptoms of all forms of syphilis of the nervous system.

SYPHILIS OF THE NERVES.

At any period of the disease syphilis is liable to attack the nerves or the ganglia.

Syphilitic degeneration of the parenchyma of the nerve itself is rare; the process usually takes place in the net-work of connective tissue between the fibres and in the sheaths of the nerves. But wherever the lesion is situated in the nerve, the symptoms are virtually the same, and manifest themselves, as in other organic neuroses, by disturbances of sensation, motion, and nutrition.

The sciatic nerve is perhaps the most frequently affected, although any one of the nerves is liable to attack. The pains produced by these lesions are not to be confounded with the rheumatoid neuralgias which occur early in the secondary stage, and which are in reality only slight functional disorders and not the result of true neuritis; nor with the pain caused by small periosteal tumors, such, for instance, as those formed upon the sternum and the ribs.

The suffering caused by syphilitic neuritis is intense, and frequently accompanied by contractions of the muscles, paresis, and paralysis. The early sciaticas—those occurring at the beginning of the secondary stage—are readily cured by specific treatment, and rarely last more than a week or two; coming on later in the disease and accompanied by evidences of degeneration, they are much more serious, and are then probably due to sclerosis or gumma formation in the connective tissue and substance of the nerve.

In like manner neuralgias of the occipital and cervical nerves are of slight import in the early secondary stage, but when occurring in the tertiary period they are to be regarded as grave symptoms of disease of the cervical vertebræ.

Syphilis not uncommonly attacks the cranial nerves and the nerves of special sense. The lesions may be of the nerves themselves, or of their sheaths, or of their canals of exit from the skull; or the symptoms may be due to the presence of neighboring gummata.

In any event there will probably be paralyses or possibly contractions of the muscles which the involved nerves supply. Although the symptoms are the same as from neuritis dependent upon other causes, a history of syphilis affords sufficient justification for assuming that the lesions are specific and for treating them as such. If they occur at a period remote from other syphilitic manifestations they must be diagnosed by the method of exclusion or by applying the therapeutic test.

The earlier the symptoms of nerve-involvement appear in the disease the more favorable is the prognosis.

The optic nerve, according to Charcot, may be the seat of fibrous metamorphosis incident to parenchymatous neuritis. The lesion of the optic nerve is usually a phenomenon of late appearance, and depends more or less upon cerebro-syphiloses.

The sense of smell is affected when pachymeningitis of the anterior cerebral fossa causes pressure upon the olfactory lobes: it may also be impaired by extensive destruction of the bones and the mucous membrane of the nose.

In like manner the auditory nerve is affected either by central lesion or by destruction of its bony envelope.

Of all the cranial nerves the motor oculi, or third pair, is the one most frequently affected. Paralysis of this nerve often makes its appearance early in the secondary stage, but is then only a transitory affection. When the lesion is deep-seated the symptoms will be ptosis, dilatation of the pupil, external strabismus, and paralysis of accommodation.

Possibly mydriasis may be the only symptom; this has been found to be the case when the lesion is situated near the lenticular ganglion and cuts off only the short ciliary branches of the nerve.

The fourth pair is rarely affected.

Lesions of the fifth pair are common, and are manifested by neuralgias or hyperæsthesias of any or all of its branches.

Affections of the sixth pair are rare; they are accompanied by diplopia, convergent strabismus, and orbital neuralgia.

The seventh pair of nerves exhibits a peculiarity in that it is so often affected early in the disease, at times within a few weeks of the appearance of chancre.

The symptoms vary according to the situation of the lesion: if it is situated on the main trunk of the nerve within the Fallopian canal, or beyond it, paralysis of the face is the only symptom; if it is situated within the skull, the usual symptoms of intracranial lesion —headache, vertigo, aphasia, convulsions, etc.—are also present.

The other cranial nerves are rarely affected.

SYPHILIS OF THE EYE.

Chancre may develop on the eyelid or on the conjunctiva. Beginning as a pimple, the lesion gradually develops into a characteristic, saucer-shaped ulceration, with rounded edges and indurated base.

Secondary syphilis may appear upon the eyelids, as well as gummata of the skin and so-called tertiary ulcers.

Syphilitic tarsitis is an inflammation of the tarsus, which produces great thickening of the lids, and in some instances is due to a diffuse gummatous infiltration. More rarely it is acute, and then must not be mistaken for an ordinary strumous inflammation of the ciliary border, from which it is to be distinguished by the thickening and induration of the tarsus.

Syphilitic conjunctivitis has been described in a few instances, the appearances being somewhat analogous to those of granular lids, the disease yielding, however, only to antisyphilitic remedies.

Syphilitic periostitis may attack the orbital margins either in a gummatous or in a sclerosing form. When the orbital walls are involved behind the capsule of Tenon, the type is almost always gummatous. The symptoms are then pain, worse at night, restriction in the mobility of the globe, squint, and diplopia. As complications there may be optic neuritis and inflammation of the cornea.

Caries of the margin of the orbit is not uncommon in syphilis, usually as the result of pre-existing periostitis.

Syphilis of the Lachrymal Apparatus.—Occasionally the lachrymal gland becomes enlarged and indurated as the result of syphilis, and hypertrophy of this body, appearing as an indurated lobulated tumor, having its situation in the upper and outer part of the orbit, should always be given careful antisyphilitic treatment before surgical measures are adopted.

Occasionally a lachrymal abscess forms in children above the internal palpebral ligament and external to the sac itself: hence the name prelachrymal abscess; it is usually due to inherited syphilis.

The lachrymal sac and nasal duct may become obstructed through periostitis and caries of the lachrymal bone or the pressure of gummatous deposits. The lachrymal apparatus in its entirety is singularly free from manifestations of syphilis.

Syphilitic Affections of the Cornea.—INTERSTITIAL KERATITIS (syphilitic, inherited, specific, parenchymatous, or diffuse keratitis).—This is a chronic inflammation of the whole thickness of the cornea, the membrane gradually passing into a condition of universal thick haziness, associated with vascularization, but almost always without ulceration.

Causes.—Inherited syphilis is the cause in between sixty and seventy per cent. of the cases. Very rarely perfectly typical examples appear with acquired syphilis. It is described under hereditary syphilis.

PUNCTATE KERATITIS, characterized by the deposition of opaque dots arranged in a triangular manner upon the posterior elastic lamina of the cornea, is usually an indication of affections of the iris, choroid, and vitreous, but may also appear both with and without iritis, and as a syphilitic inflammation. It occurs in the late or gummatous period of syphilis, but is seen also in children before puberty as one of the forms of inherited syphilis. The treatment is the same as that described under interstitial keratitis.

Syphilis of the Sclera.—A certain number of cases of scleritis and episcleritis—that is, inflammation of the sclera itself or its overlying tissue—have been ascribed to acquired syphilis and yielded to the ordinary remedies. So, also, in the late stages of syphilis, a true gummatous scleritis may develop, characterized by the formation of yellowish-brown and semi-translucent nodules on this membrane.

Syphilis of the Iris.—Fifty per cent. of all cases of iritis are syphilitic, and are frequently associated with choroiditis.

There are four distinct varieties of the affection.

1. SYPHILITIC PLASTIC IRITIS.—This may occur in the early stages of general syphilis, usually between the second and the ninth month after the initial lesion, and is characterized by the ordinary symptoms of iritis,—namely, fine pericorneal injection, contracted, sluggish, or immobile pupil, discolored iris, abnormal reaction to a mydriatic, slight tenderness on pressure, the formation of attachments between the margin of the iris and the capsule of the lens (posterior synechiæ), and severe pain in the brow and head, worse at night.

The symptoms do not differ from those of a simple iritis from other cause, and are of themselves not characteristic of the disease, yet the lesions are due to the syphilitic taint and yield to the ordinary constitutional remedies and local measures.

2. SYPHILITIC PARENCHYMATOUS IRITIS, or true syphilitic iritis, belongs to the parenchymatous variety of the affection, being an accompaniment of secondary syphilis, and is characterized by a deposit of yellowish-red nodules on the ciliary or the pupillary border of the inflamed iris, comparable to the papules and condylomata of the stage at which it occurs, and hence called iritis papulosa or condylomatous iritis. These small nodules vary in number from one to four, and are gradually absorbed under treatment, leaving faint scars in the iris-tissue to mark their former situation. Sometimes instead of distinct nodules there are local swellings in the iris-tissue, the membrane

being attached at these situations by broad and moderately soft synechiæ to the capsule of the lens, causing fixed distortion of the pupil, often "umbrella" iris, and impairment or loss of vision.

3. GUMMATOUS IRITIS—gumma of the iris—occurs in the late or tertiary stages of syphilis, and is characterized by the development of large yellowish nodules, usually on the ciliary border of the iris, and strongly analogous to gummata elsewhere in the body.

Occasionally at this late stage an iritis unassociated with nodules appears, somewhat resembling the plastic type of the disease, and probably the relapse of a plastic iritis which occurred in an early stage, owing to a failure in the absorption of the original synechiæ.

4. SEROUS IRITIS (more properly, serous cyclitis), characterized by a serous or sero-plastic exudate, deepening of the anterior chamber, slight dilatation of the pupil, haziness of the cornea, and opaque dots on its posterior elastic membrane arranged in a triangular manner, is an unusual variety of iritis as the result of acquired syphilis in the secondary stage, although common from many other causes.

Prognosis.—The prognosis of the various types of syphilitic iritis is good, provided the cases are seen early, before firm adhesions form and much exudation pours out into the pupillary space, causing either its occlusion or its exclusion. When thoroughly cured, relapses are infrequent. Commonly both eyes are attacked, one a little later than its fellow; occasionally the onset is simultaneous.

Treatment.—This should consist in the free use of atropine drops, four grains to the ounce, hot compresses and leeching the temple to relieve pain and enhance the action of the atropine, and the persistent use of such antisyphilitic remedies as are indicated by the stage at which the iritis appears. In stubborn cases, and especially in gummatous iritis, subconjunctival injections of bichloride of mercury may be used with benefit. Success depends upon beginning the treatment early enough to tear loose the synechiæ by the use of atropine, which, except in the cases of serous iritis where there is a tendency to rise of intra-ocular tension, must be vigorously used until all signs of irritation have passed away and a perfectly round pupil is obtained.

Inherited syphilis may also produce iritis, the disease, characterized by much exudation and rapid occlusion of the pupil, usually appearing between the ages of two and fifteen months, and being very much more frequent in girls than in boys. It is probable that all iritis occurring in young children is due to syphilis.

Subacute, chronic, and so-called quiet iritis may also be caused by syphilis, the latter, as its name implies, being unassociated with much pain or ciliary congestion, the progressive dimness of vision usually leading to its discovery.

Syphilis of the Ciliary Body.—Independently of the fact that this structure is commonly involved in all the severe types of inflammation of the iris, forming the so-called irido-cyclitis, and that serous iritis is really a manifestation of inflammation of the ciliary body, syphilis strictly confined to this structure is uncommon. In a few instances, however, gummata thus located have been described.

The treatment of cyclitis of syphilitic origin, or, more properly, irido-cyclitis, does not differ from that of iritis.

Syphilis of the Choroid, Retina, and Optic Nerve.—The most important lesions of these structures, discoverable only with the ophthalmoscope, are the following:

DEEP CHOROIDITIS, characterized in its diffuse exudative variety by yellowish-white plaques, going on later to absorption, heaping of pigment, and atrophy of the retina (choroido-retinitis), and in its disseminated variety by the formation of numerous round and oval spots in the fundus oculi, which have a characteristic punched-out look and the margins of which are bordered with black pigment. In the later stages opacities in the vitreous humor are common, and atrophy of the optic nerve may take place. Vision is often seriously affected, especially if the region of the macula is involved.

The various types of choroiditis which are due to acquired syphilis appear from six months to two years after the initial lesion; sometimes ten years elapse before their appearance.

Choroiditis of similar type may be due to inherited syphilis, and develops between the sixth month and the third year of life. The treatment consists in the exhibition of the usual antisyphilitic remedies. The subconjunctival injections of sublimate are said to be especially efficacious.

There are a number of other types of choroiditis which probably depend upon syphilis, but that named is the most important.

SYPHILITIC RETINITIS occurs in various types. The first variety, ordinarily called choroido-retinitis, is really a disease of the choroid. The most important symptoms are opacity of the vitreous (syphilitic hyalitis), usually in the form of dust-like particles; loss of transparency of the retina around the head of the optic nerve, which is unduly hyperæmic; and numerous yellow or white spots of exudation bounded by pigment lying beneath the vessels of the retina. Vision is much affected, especially in dim lights, the field of vision is contracted, and the patient complains of shimmerings, spots, circles, dancing lights, and distortion of objects.

Sometimes the disease is more truly located in the retina, which becomes affected with a gray opacity, the optic nerve entrance being yellowish red in color, while floating opacities arise in the vitreous; occasionally there are hemorrhages.

Of an unusual type and one belonging to the late manifestations is a central retinitis, located largely in the macular regions, and characterized by the appearance of numerous yellow or yellowish-white spots and pigment-dots.

Retinitis may occur both in congenital and in acquired syphilis. In the acquired form it appears usually from one to two years after infection, but sometimes as early as the sixth month. Generally both eyes are involved.

In the hereditary disease it arises, like choroiditis, between the sixth month and the third year of life.

The treatment consists in the exhibition of the ordinary antisyphilitic remedies, which should be vigorously pushed in order to prevent secondary changes in the optic nerve and consequent blindness. The eye should be protected with dark glasses, and the accommodation paralyzed with a weak solution of atropine.

SYPHILITIC OPTIC NEURITIS, characterized by swelling of the nerve-head, distention of the veins, which become darker in color and tortuous, and hemorrhages upon the swollen papilla or in its immediate neighborhood, may be caused by the formation of an intracranial product, for example, a gumma, or may develop as an essential sign of syphilis.

Rapid mercurialization should be practised, to be followed later by the iodides, and if the exudation is quickly absorbed the prognosis as to vision may be good; otherwise the tissues are strangled, and there results

Atrophy of the Optic Nerve.—In addition to this consecutive atrophy of the optic nerve the result of a syphilitic neuritis, a primary atrophy occurs, as well as the various types of degeneration of the nerve-head, which are due to general causes resulting from syphilis, for example, locomotor ataxia.

The usual symptoms of optic nerve atrophy are progressive loss of vision, ever-increasing restriction of the field of vision, and the ophthalmoscopic appearances of atrophy,—namely, pallor of the disk, absence of capillaries, and shrinking of the size of the vessels.

Syphilitic Palsies of the External Ocular Muscles.—The most frequent cause of paralysis of the external ocular muscles is syphilis, fully one-half of the cases having this origin. The usual lesion is an inflammation or gummatous change affecting the nerve at the base of the brain, or in the orbit, or there may be disease of the nuclei of the nerves or of the brain in their immediate vicinity, or, finally, the lesions may exist in the third ventricle, in the aqueduct of Sylvius, or in the fourth ventricle. Syphilitic paralysis is usually but not always one of the late manifestations of syphilis. The oculomotor nerve is the one most frequently affected. The involvement is often a forerunner of tabes or general paralysis.

In rare instances there is paralysis of the ocular muscles as the result of inherited syphilis.

The usual symptoms of palsy of the ocular muscles are present,—namely, double vision, strabismus, limitation of movement in the direction of the affected muscles, vertigo, and an altered position of the carriage of the head, which is apt to be turned in the direction in which the patient is least troubled by the double images.

Ophthalmoplegia is a term used to characterize a loss of power in one or more of the eye-muscles, which gradually increases and involves other muscles until all of them may be paralyzed. This may be caused by hereditary and also by constitutional syphilis.

In addition to the paralysis of the external muscles of the eye there are various conditions of the pupil and ciliary body which arise under the influence of syphilis; thus, if the oculo-motor is paralyzed and those branches which supply the iris and the ciliary body are affected, there will be dilatation of the pupil and loss of accommodation. Occasionally there is a wide dilatation of one pupil without affection of the ciliary body, and inequality of the pupils may arise in the course of a focal syphilitic brain-lesion. The treatment of these ocular palsies, both external and internal, demands the use of mercury and ascending doses of potassium iodide.

SYPHILIS OF THE EAR.

The auricle and meatus may exhibit any of the characteristic lesions of constitutional syphilis.

In the secondary stage of the disease dry or moist papules are observed. These when they involve the meatus are prone to ulcerate or to form papular overgrowths, accompanied by marked purulent secretion. As a result of free suppuration and blocking of the canal, perforation of the drum and suppurative disease of the middle ear may result. Condylomata are the most frequent specific lesions of the meatus.

Gummata of the external auditory meatus appear in the form of moderate-sized chronic abscesses. These are, however, extremely rare.

The middle ear if involved shows the changes incident to catarrhal inflammation. This is usually secondary to suppurating lesions of the throat.

The pharyngeal opening of the Eustachian tube is frequently the seat of chancre,—the infection being carried by the Eustachian catheter,—of mucous patches, and of gummata. Cicatricial contraction following these lesions may completely block the Eustachian tube. Syphilitic otitis media may assume the suppurative or the sclerosing form. Meningitis, sinus thrombosis, facial palsy, and the other complications of non-specific middle-ear disease may develop. Local treatment is of cardinal importance.

The labyrinth is exceptionally attacked in the early secondary stage of the disease; usually this is a late tertiary manifestation, and it is much more frequent in congenital than in acquired syphilis. Tinnitus, vertigo, and sudden onset of deafness are the chief symptoms.

Diagnosis.—This is founded on the history of syphilis and the absence of other discoverable cause for disturbance of hearing. The rapid onset of deafness is also characteristic. The prognosis always should be guarded. The most severe cases sometimes recover promptly as the result of specific treatment; the mildest cases may remain uninfluenced by mercury and the iodides.

Treatment.—This when the meatus is involved should comprise thorough cleansing, the use of astringents, and the application of cauterants to ulcerating spots. Extensive overgrowths and polypi should be detached by snaring or curetting.

When the labyrinth is involved the specific treatment should be pushed to its extreme limit. The prognosis is unfavorable in these cases.

SYPHILIS OF THE RESPIRATORY TRACT.

Syphilis of the Nose.—Primary lesions of the nose are extremely rare. A few cases are recorded due to the use of infected instruments, and in some instances the disease has arisen from unnatural practices.

Secondary manifestations, in the form of moist papules, frequently appear about the nostrils.

Gummata involving the external nose exhibit a predilection for the wings, the point, the cartilaginous septum, and the neighborhood of the tear-ducts. These gummata, beginning first in the subcutaneous tissues, extend in depth, involving the bones or cartilages beneath. When there is also gummatous infiltration of the walls of the nasal cavity marked deformity results.

Syphilis of the Nasal Cavities.

1. Syphilitic rhinitis.
    Acute.
    Chronic; hypertrophic.
    atrophic.
2. Gummata.
    Nodular.
    Infiltrating.

ACUTE SYPHILITIC RHINITIS.—Acute rhinitis, one of the most frequent secondaries of hereditary syphilis, is comparatively rare in the acquired form of the disease. It begins much as does a simple catarrhal rhinitis, and at first cannot be distinguished from this affection; later it develops one of the chief characteristics of syphilis,—polymorphism. If the nasal cavities are examined, the inflammation will be found to vary in intensity even in different parts of the same nostril. Ecchymoses, abrasions, superficial ulcerations, and at times mucous patches may be seen, particularly on the septum and the lower turbinals. The posterior nares are at first but slightly involved; later they show the characteristic thickening, hyperæmia, and dusky redness of acute inflammation; by this time deeper lesions will have developed anteriorly.

Acute specific rhinitis differs from the catarrhal inflammation by persisting in spite of careful treatment and by giving blood-stained discharge or hemorrhage not at the beginning of the attack, but later when erosions and ulcers have developed. Usually the accessory nasal cavities are but slightly involved. Hypertrophic and ultimately atrophic rhinitis may be the direct sequelæ of the acute inflammation.

HYPERTROPHIC RHINITIS presents a spongy, swollen, polypoid mucous membrane, so thickened that practically no breathing-space is left. Ulceration is often present, particularly on the nasal septum, the lesion here being sharply defined and exhibiting an unhealthy, readily bleeding surface.

The secretion is abundant, often blood-stained, and stinking. The mucous membrane of the maxillary, frontal, and sphenoidal sinuses may become involved, causing, from retained secretions, severe headache or neuralgic pain, and finally abscess. Since the mucous membrane is closely applied to the nasal bones and cartilages, particularly that overlying the lower turbinals, perichondritis, periostitis, ostitis, caries, and necrosis generally complicate chronic specific rhinitis. Bone- or cartilage-involvement commonly gives rise to no subjective symptoms beyond deformity and blood-stained discharge, complete perforation of the septum often taking place without the patient being aware of it. The nostrils may be so effectually closed that mouth-breathing, with its evil consequences, results. The sense of smell may be lost, and the tear-ducts may be chronically inflamed or may be obliterated.

ATROPHIC RHINITIS follows the hypertrophic inflammation, or may be caused by the wasting which follows gummatous infiltration. The turbinals are often involved in the atrophic process, and may be covered by thick offensive crusts concealing ulcerations. The abnormal roominess of the nasal cavities, the thin, bloodless, scar-like mucous membrane, and the fetor are characteristic of atrophic rhinitis, whether it be specific or not.

Diagnosis.—The diagnosis of chronic syphilitic rhinitis must be based on a specific history or associated signs of the disease, since it does not differ from the catarrh observed in non-syphilitics, particularly in those of a strumous diathesis.

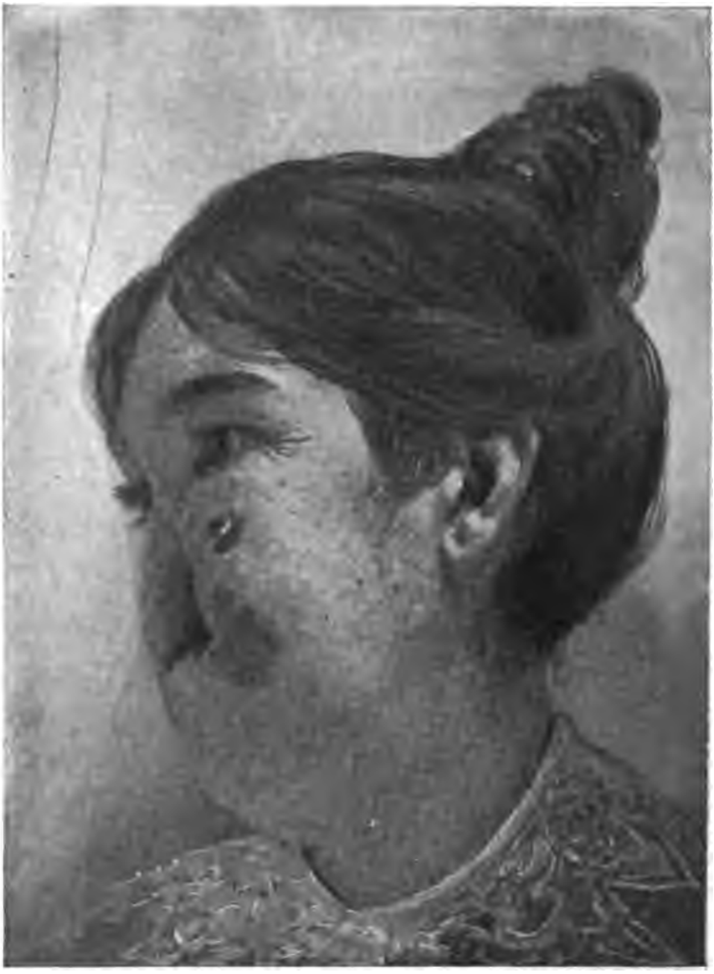
GUMMATA.—These lesions when they are developed in the nasal cavity are usually late tertiaries. If not treated promptly and energetically they produce conspicuous and irremediable deformity of the external nose. They appear as distinct nodules or as diffuse infiltrations.

The GUMMATOUS NODULE attacks by preference the cartilaginous septum and the floor of the nasal canals. Occasionally it is found on or near the alar cartilages. It is usually single, grows slowly, rarely reaching the size of a small cherry, and is often associated with syphilitic rhinitis or gummatous infiltration. Though painless in its course, if untreated it commonly erodes the underlying cartilage or bone. The resulting deformity is much less than that incident to the breaking down of gummatous infiltration. Gummata growing from the mucous membrane covering the alar cartilages perforate the latter and open into the nasal cavity. When they originate in the cartilage itself the perforation may be external. In the latter case ulceration may extend to the lower border of the cartilage, and be followed by a peculiar pinching deformity, which may be symmetrical.

Gummata on the floor of the nose are rarely detected until they have broken down and formed ulcers, or until they have opened into the mouth. The upper portion of the nasal cavity is rarely attacked by the nodular gumma.

GUMMATOUS INFILTRATION is the affection which causes the most marked nasal deformities. It involves both the mucous membrane and the underlying periosteum and perichondrium, and extends rapidly both in depth and in surface. Because of rapid interference with blood-supply, it is prone to slough, the destructive process extending wide of the original infiltrate. Bones and cartilages rapidly necrose; there may be complete destruction of all the cartilages and the bones immediately surrounding the nasal space. Necrosis of the cribriform plate of the ethmoid and the vomer, by taking away the support of the nasal bones, allows them to sink, even though they are not involved, producing the so-called saddle-back nose. This is more commonly due to associated necrosis of these bones, which may cause complete destruction of the nose. (Fig. 309.) From extension of the inflammation the ethmoid, the sphenoid, the palatal bone, and

FIG. 309.



Gummatous ulceration destroying the nose.
(From the collection of photographs of Dr. George Henry Fox.)

the superior maxillaries, particularly the palatal, nasal, and alveolar processes, may become extensively diseased.

Diagnosis.—Gummata and gummatous infiltrations, involving the mucous membrane of the nose, are characterized by ordinary catarrhal symptoms, but differ from catarrh in the fact that the symptoms are constantly referred to the same diseased area. When ulceration becomes deep, involving bones, and before this in hypertrophic and atrophic rhinitis, the discharge is extremely offensive. On examination the destructive process is often found to be wide-spread. Rounded ulcers, often covered with thick crusts, mark the position where, on probing, dead bone is detected. As a result of gummatous involvement of the cribriform plate, lethal inflammation may extend to the meninges of the brain.

In the early stages, where there is simply beginning infiltration, the symptoms and lesions are so like those of chronic catarrh that differential diagnosis may be impossible. The history of the case, the presence of possibly specific lesions resisting the ordinary catarrhal treatment, and finally the therapeutic test, should decide this question before destruction of bone has taken place.

When perforation of the septum is found the disease is almost certainly syphilitic, though tuberculous lesions may produce the same result.

Syphilitic involvement of the olfactory nerves, commonly due to pachymeningitis of the base, may cause anosmia.

Treatment consists in the internal administration of specifics and in local cleanliness, accomplished by antiseptic and stimulating sprays and vapors. Exceptionally the bone-lesions are premature,—*i.e.*, they complicate secondary syphilis; mercury should then be combined with the iodides. When these lesions are distinctly gummatous in type,—and under such circumstances they are nearly always late tertiaries,—the iodides form the basis of treatment, supplemented by mercury, administered preferably by inunctions. When dead bone is found it should be removed. This is accomplished under ether by means of the finger of the surgeon aided by a curette. Bleeding is often profuse, but is readily controlled by packing. Following this the whole nasal cavity must be cleaned every two hours with sprays, the first containing hydrogen peroxide twenty-five per cent., the second dilute solutions of thymol, or Dobell's solution, or other disinfectants and antiseptics. Insufflations of iodoform and iodol may be serviceable after the cleansing spray. When a small portion of bone is necrotic it is safe to wait until this is loosened before attempting to remove it, at the same time pushing the constitutional treatment.

For the deformity of the nose which sometimes results from cicatricial contraction following extensive necroses, plastic operations of various kinds are indicated. Perhaps the most satisfactory from a cosmetic stand-point is the insertion of an artificial bridge of gold, silver, or celluloid. Over this the loosened skin is drawn by the percutaneous suture. When there is not enough healthy tissue for this procedure, the fitting on of an artificial nose is advisable.

Syphilis of the Larynx.—Secondary lesions of the larynx appear either as a general erythema, not distinguishable from that incident to cold or irritation, or as mucous patches, which are mostly found on the aryepiglottic folds, the vocal bands, the arytenoid cartilages, and the borders of the epiglottis. These papules are sometimes converted into superficial erosions, but usually yield quickly to constitutional treatment, leaving no trace, save at times alteration of the voice, due to slight thickening of the mucous membrane. Very exceptionally these erosions become true ulcers, closely simulating those incident to gumma, except that they are not so deep nor so destructive.

Tertiary lesions may be expressed in the form of a diffuse gummatous infiltration or circumscribed gumma.

DIFFUSE GUMMATOUS INFILTRATION usually attacks the epiglottis, the vocal cords, and the posterior wall of the larynx. The mucous membrane is reddened and thickened, and there is ill-defined, wide-spread infiltration of the surrounding tissues. If ulceration takes place it is generally superficial, though a large surface may be involved.

Symptoms.—The symptoms are due to disturbance of function incident to infiltration. There is little or no pain. Until the voice becomes husky the patient's attention is not markedly attracted to the throat. Very slowly progressing ulceration and subsequent cicatricial contraction produce marked alterations in the voice and may obstruct breathing. Exceptionally there is immediate total aphonia, followed later by partial stenosis, with the constitutional symptoms dependent upon dyspnœa.

Diagnosis.—This is founded upon the discovery of a thickened, often superficially ulcerated area, without associated diseases of the lungs, and with a preceding history of syphilis and often other manifestations of the disease.

Tuberculous laryngitis, the only affection with which it is liable to be confounded, is hardly ever encountered in conjunction with healthy lungs.

CIRCUMSCRIBED GUMMATA involve by preference the epiglottis, the aryepiglottic folds, the true and false vocal cords, and the posterior wall of the larynx. At first they appear as rounded elevations, the mucous covering of which is thickened; later softening takes place and deep destructive ulcerations are formed, ultimately resulting in cicatricial contraction, which seriously interferes with the function of the larynx. During the ulcerating stage acute œdema sometimes develops and threatens death from suffocation.

Symptoms.—The symptoms are much the same as those of diffuse gummatous infiltration, except that the discharge is more profuse, pain and tenderness are more frequently noted, and the functional disturbances are more marked.

Diagnosis.—This is founded on laryngeal inflammation associated with nodules and ulcers and the existence of a history and other signs of syphilis.

In distinguishing these lesions from those of *tuberculosis* it must be remembered that the mucous membrane surrounding syphilitic ulcers is practically normal in color or congested, not pale. The development of the gummatous infiltration is much more rapid, and the therapeutic test will usually lead to a correct diagnosis.

The syphilitic ulcers develop quickly, sometimes in a few days, and are surrounded by reddened, œdematous mucous membrane. The ulcers are usually single, and involve by preference the upper surface of the epiglottis. Tubercular lesions require months for development.

The distinction between gummatous and carcinomatous infiltration is dependent on somewhat the same difference in symptoms, though occasionally microscopic examination of an excised piece will be necessary before the true nature of the case can be determined. The differential diagnosis between syphilitic, tuberculous, and cancerous laryngitis may be tabulated as follows:

Syphilis.	*Tubercle.*	*Cancer.*
Development of ulcer acute, occupying only a few days.	Development slow; follows throat symptoms after several months.	Intermediate in time; appearance of ulcers in a few weeks.
Considerable irregular inflammatory or œdematous swelling.	Uniform, pale swelling, looking like an infiltration.	Nodular excrescences and acute inflammation of neighboring mucous membrane.
Epiglottis affected, if at all, on upper surface.	Lower surface.	No uniformity.
Ulcer solitary; rarely more than two.	Ulcers numerous.	Ulcer solitary.
Proceeds from centre to periphery, or from above downward.	The reverse is true.	Irregular in its course.

Syphilis.	*Tubercle.*	*Cancer.*
Deep, round, or oval.	Generally round.	Irregular in shape.
Diameter of one-third to one inch.	Diameter much smaller (one-sixth to one-twelfth inch).	Diameter much smaller.
No cachexia.	Phthisical appearance.	Cachexia.
Treatment usually highly beneficial.	Treatment has but very moderate effect.	Treatment has no effect.

Prognosis.—The prognosis of gummatous laryngitis is extremely good if the diagnosis is made before ulceration has had time to effect much destruction of tissue. Resolution under specific treatment is usually prompt. When ulceration is extensive, medicine cannot prevent cicatricial contraction and interference with function. Under these circumstances, when dyspnœa sets in, dilatation of the strictured portion, often supplemented by internal laryngotomy and the wearing of an intubation tube, or tracheotomy, will be necessary. In addition to constitutional treatment, during the gummatous stage of laryngitis the lesion should be touched daily with iodine, 1 part, potassium iodide, 10 parts, glycerin, 100 parts; it having been previously sprayed and cleaned by antiseptic solution of sublimate 1 to 2000. Following this the lesion should be dusted with iodol.

Syphilis of the Lungs.—The trachea and bronchi exhibit the lesions of secondary syphilis in the form of mucous patches, which in the few observed cases were situated on the posterior walls of these tubes and were credited with causing an obstinate bronchitis, yielding only to specific treatment.

GUMMATOUS ULCERATION of the trachea and bronchi may be extensive and superficial, or localized and deep. It is commonly placed about the tracheal bifurcation, and may cause necrosis of one or more rings, these in some few cases having been coughed up. As a result of this gummatous ulceration the surrounding organs are involved, and in some cases the œsophagus, the aorta, and the posterior mediastinum have been opened.

If the respiratory tubes recover from the inflammatory process, subsequent cicatricial contraction may seriously embarrass respiration.

Symptoms.—When the trachea is involved there may be an obstinate cough, with expectoration of blood-stained sputa, and some pain and tenderness behind the sternum. Large tracheal râles may be heard on auscultation. When the bronchi are invaded the prognosis is less favorable than when the trachea alone is attacked.

Syphilis may attack the lungs in the form of acute catarrhal or croupous pneumonia, somewhat atypical in development, symptomatology, and course, and yielding to constitutional treatment. This is exceptional.

Lung-symptoms depending on syphilis usually develop in the late tertiary period. Two forms of lesions are observed:

1. Diffuse sclerosis, characterized by bronchial catarrh, and alternate areas of dulness and resonance.

2. Circumscribed syphilitic gumma, single or multiple, usually found in the middle third of the lungs, but occurring also at the apices. The patient may exhibit all the symptoms of typical phthisis.

A form of chronic pneumonia characterized by diffuse interstitial infiltration is sometimes characteristic of hereditary syphilis. This may involve the entire lung or only a portion of it, and is a frequent cause of death. The alveolar septa are so thickened by the specific infiltrate that the air-spaces are greatly encroached upon, the lungs cannot expand, and the pulmonary circulation is interfered with.

GUMMATOUS PULMONITIS, the so-called syphilitic phthisis, under which head are included the diffuse and circumscribed infiltrations, develops as an ordinary case of consumption, except that the constitutional symptoms are at first less marked and the course is less rapid. The disease begins with a cough, slight dyspnœa, and moderate expectoration, usually without fever. Percussion dulness and bronchial breathing are found over the diseased area. As the gummatous infiltrate increases, the expectoration becomes more profuse and cavities form. Hectic is developed, and all the characteristic symptoms of advanced phthisis appear.

The mid-portions of the lungs are, according to the majority of reports, most frequently affected.

Diagnosis.—The diagnosis is founded upon a syphilitic history and the presence of other manifestations of the disease, such as laryngeal lesions, perforation of the palate, and skin cicatrices. Tubercle bacilli are not found in the expectoration. A two weeks' treatment by inunctions supplemented by iodide internally should produce marked improvement of symptoms if the disease is syphilis. Tuberculous involvement is made worse by such treatment.

Primary involvement of the pleura, with characteristic symptoms of pleurisy, is almost unknown. There may, however, be a pleuritis with effusion secondary to specific pulmonary involvement.

Treatment.—This is practically the same as that applicable to cases of pulmonary tuberculosis, with the addition of potassium iodide pushed to toleration, supplemented by inunctious of mercury.

CHAPTER XXVI.

SYPHILIS OF THE BONES AND JOINTS.—OF THE MUSCLES.—OF THE HEART AND BLOOD-VESSELS.—OF THE LYMPHATIC SYSTEM.—OF THE LIVER.—OF THE SPLEEN.—OF THE PANCREAS.—OF THE GENITO-URINARY ORGANS.

Lesions of the bones are among the most frequent manifestations of constitutional syphilis; indeed, as a seat of predilection, the osseous system takes second rank, being surpassed only by the skin and mucous membrane.

Symptoms of bone-involvement may appear very early, at times even before the skin eruptions. Usually the lesions are distinctly tertiary in type and in their time of appearance.

The scrofulous temperament, cachexias which are liable to be attended with alteration of the bones, as gout or rheumatism, and particularly traumatism, often slight and unnoticed in itself, are causes which predispose to the development of specific bone-lesions. Superficially placed bones, such as the frontal bone, clavicle, sternum, radius, ulna, and tibia, are affected most frequently mainly because they are so often exposed to slight injury.

The lesions produced by syphilis vary from a simple periostitis to the formation of typical gummata. These lesions may undergo resolution, or may be followed by exostosis, eburnation, caries, and necrosis. They may be classed under the following heads:

1. Simple osteoperiostitis.
2. Rarefying ostitis.
3. Gummatous osteoperiostitis.

Osteoperiostitis, also called *precocious periostitis*, may develop at the time of skin eruption, or even before this, within three weeks of the appearance of a chancre; more commonly it occurs either in the first three months of the disease or in the tertiary period. Pathologically it does not differ from osteoperiostitis due to non-specific causes. The periosteum becomes hyperæmic, and there is cellular infiltration of its deeper layers and the contiguous portion of the bone. The bones of the cranium, the tibia, the ribs, the sternum, and the clavicle are most frequently affected.

Symptoms.—These are subacute in type. On examination there is detected a tender, slightly elastic swelling, evidently growing from the bone; the skin may be slightly puffed and reddened, and the pain is often intense, especially at night. Usually the symptoms yield promptly to treatment, the swelling disappearing without leaving a trace of its seat. Sometimes, however, in place of resolution, osteogenesis takes place, and bony nodules called *osteophytes* permanently mark the seat of trouble; or from a deposit of bone on the walls of the Haversian canals the osseous tissue may become unduly dense, resulting in *eburnation.*

Rarefying Ostitis.—When the inflammation is more intense the cellular infiltrate not only invades the lower layer of the periosteum and the bone surface, but penetrates along the course of the Haversian canals, eroding their bony walls, and substituting for the solid osseous substance soft embryonal tissue. If the process is acute the normal tissue may entirely disappear at the seat of infiltration, and suppuration may take place, resulting in the formation of a bone abscess and in caries or necrosis.

Usually the embryonal tissue gradually encroaches upon the bone-tissue, till the latter much resembles sponge in shape and structure, or the infiltrate may become organized, obliterating the lumen of the Haversian canals, and filling the medullary canal with a hard, heavy, compact, osseous tissue, producing eburnation. Caries and necrosis may also occur at the seat of eburnation as a result of ischæmia incident to obliteration of the Haversian canals.

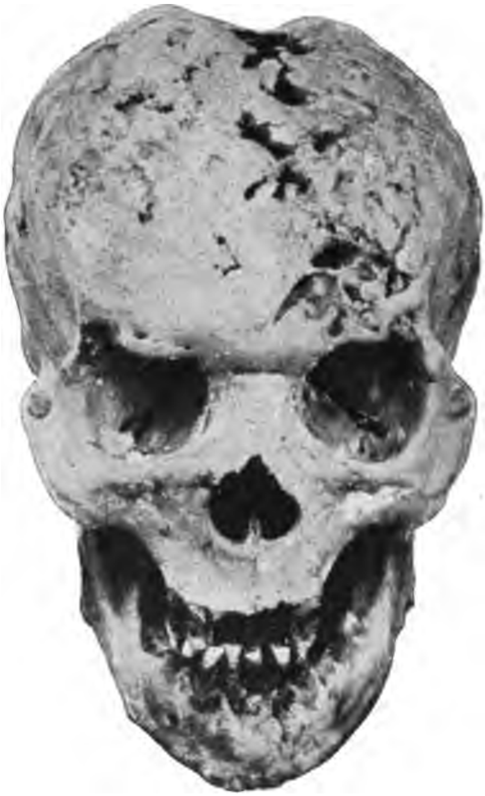
Gummatous Periostitis, Ostitis, and Osteomyelitis.—While the simple and rarefying forms of osteoperiostitis offer no clinical or pathological features which will distinguish them from similar lesions due to causes other than syphilis, the formation of gummata in bone points definitely to syphilis. The lesions appear as tumors varying in size and exhibiting a tendency towards centric caseous degeneration. These tumors are formed by rarefying ostitis in which the superabundant subperiosteal or medullary embryonal tissue undergoes the changes and arrangement characteristic of the gumma. These gummata may develop in the deeper layer of the periosteum, in the bone-substance, or in the medullary cavity. They are usually multiple, and may invade any portion of the skeleton.

The gummatous involvement of the bone may be circumscribed or diffuse.

CIRCUMSCRIBED GUMMATOUS OSTEOMYELITIS appears in long bones in the form of nodules developing in the medullary canal. Centrally they are found to be softened or undergoing caseous degeneration, while peripherally they are surrounded by a sclerosed area. In the spongy tissue the gummata are imperfectly encapsulated by the same fibrous formation.

Diffuse Gummatous Osteomyelitis.—The lesions of this form of bone syphilis more frequently involve the soft parts in gummatous changes, resulting in the formation of fistulæ leading to the bone. The periosteum is always infiltrated; the bone is greatly deformed and appears worm-eaten. Its surface is irregular, studded with osteophytes, perforated with small or large openings, and exceedingly unequal. (Figs. 310, 311.) Some of these perforations are small, others as large as two-fifths of an inch in diameter. On section of the bone hyperostosis and eburnation will be found in some regions, and marked rarefaction in others, the whole bone being considerably increased in volume. The new ossification is exceedingly irregular in position and consistence. The bone is often so brittle that the least effort is enough to break it. Indeed, the irregular eburnation and rarefaction are considered by Ollier as characteristic of the osseous lesions of syphilis.

FIG. 310.

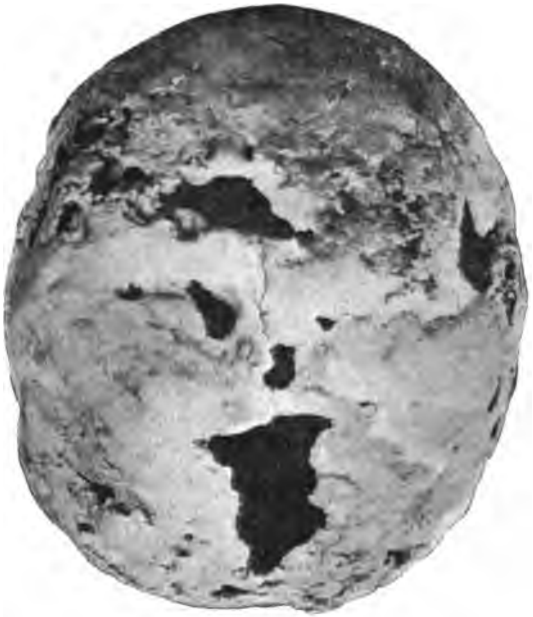


Skull showing the results of gummatous osteoperiostitis.

All these lesions are marked by absence of suppuration and by the rarity of extensive necrosis. As a result of intense rarefying periostitis, particularly where this is diffuse, there is always destruction of bone-tissue. When the flat bones are attacked, lesions may be circular or semicircular in arrangement. This circinate arrangement is rarely observed in the long bones. Nearly always associated with the destruction of tissue there is noticed peripherally a formative ostitis. This follows the course of destructive action, resulting in overgrowth and eburnation.

Necrosis usually results in consequence of the too energetic osteogenetic action. Most of the sequestra are found to be eburnated. Sometimes the bone seems almost normal in structure, often being cut off from its nutrition by a peripheral gummatous infiltration, which obliterates its vessels and deprives it of nutrition.

FIG. 311.



Vault of the cranium exhibiting the results of gummatous osteoperiostitis.

Tegumentary lesions may cause bone necrosis by extension of infiltration to the periosteum ; thus the nasal bones and cartilages are most frequently destroyed.

The more chronic forms resulting in osteosclerosis and osteoporosis are attended with few subjective symptoms, perhaps nothing more than boring nocturnal pains, which are usually considered as rheumatic.

Symptoms.—The symptoms of gummatous bone-involvement are, when the lesion is circumscribed and begins in the periosteum, fairly characteristic. There is formed a painless, sometimes excessively painful, non-inflammatory tumor of slow growth, which softens centrally and exhibits a peripheral ring of dense induration. Several bones are often invaded at the same time, or the lesion is multiple, and there is commonly a syphilitic history to be elicited. The diagnosis between syphilitic and tubercular ostitis will be founded on the points of difference formulated in the following table:

Syphilitic Ostitis.	*Tubercular Ostitis.*
Syphilitic ostitis occurs in varying physical conditions.	Ostitis of tuberculosis occurs in persons who have other symptoms of this disease.
Begins most frequently in the periosteum.	Begins in the medulla.
Tends to the formation of new bone or necrosis.	Tends to disintegration of the parts.
Is often unaccompanied by suppuration.	Generally terminates in the formation of pus.
Does not involve neighboring articulations.	Apt to do so.
Frequent in bones of the cranium.	Scarcely ever found in this situation.
Histologically, consists of a relatively large mass of granulation-tissue.	Made up of a varying number of tubercle granulations and surrounded by isolated granules.
In the majority of cases can be cured, or at least arrested, if taken in time, by judicious specific treatment.	Nothing short of operative interference materially affects the course of this disease.

Osteosyphilosis of the Cranium.—Precocious osteoperiostitis and ostitis, together with tertiary exostoses, are frequently observed in the bones of the cranium. The exostoses may develop upon both the external and the internal table. In the latter case they are dangerous to life from pressure and from the meningitis which they excite. Rarefying ostitis and gummatous periostitis are often observed, with consecutive eburnation, as are also circumscribed gummata. These lesions may develop in the diploe, or in the pericranium, or in the dura, involving the bone subsequently.

When placed upon the cranium the gummatous lesions exhibit a circinate arrangement and cause but scanty suppuration. Frequently small and multiple gummata will involve a considerable extent of surface, circumscribing a large portion of the internal or the external table, which eburnates, becomes ischæmic, and necroses. When the pericranium alone is involved, the external table is destroyed. When the syphiloma is located in the dura mater, it is the internal table alone that is involved. When syphilomata of the pericranium and the dura are developed on opposite portions of the same bone, complete perforation may result. This may also follow from a gumma developing in the diploe.

Gummata of the dura mater are accompanied by a circumscribed pachymeningitis, which is sometimes hemorrhagic. Frequently these gummata developing upon the dura are followed by no external signs, though sometimes they may consecutively involve the soft tissues and suppurate. Dry caries resulting in the formation of stellar cicatrices, sometimes in complete perforation, due to gummatous infiltration followed by absorption, is comparatively rare. Usually the soft parts are involved, and there is the ordinary form of caries or necrosis.

The external exostoses of the cranial bones are similar to those observed in the other parts of the body. Exostoses encroaching upon the brain are interesting from the fact that they sometimes occasion compression symptoms and excite meningitis or encephalitis.

These projections are noticed over the frontal, parietal, temporal, and occipital bones.

Some instances of general hyperostosis due to syphilis have been observed.

The bones of the face, particularly those of the nose, are favorite seats of gummatous infiltration. The affection may develop primarily in the bone, or may be secondary to ulcerating or tubercular gumma of the soft parts. The superior maxilla frequently exhibits these lesions, particularly the alveolus, the palatal plate, and the nasal process. The disease usually goes on to necrosis.

The vertebræ exhibit the ordinary bone-lesions of syphilis, but are perhaps especially apt to suffer from circumscribed gummata. Caries and necrosis may develop, followed by spinal deformity,—syphilitic Pott's disease. As in tubercular disease of the spine, the cord and its envelopes, the spinal nerves, and the surrounding parts may be affected either by pressure of the infiltrate or by involvement in the inflammatory process.

Osteosyphilosis of the foramina may from the swelling cause pain, analgesia, or paralysis, due to pressure upon the spinal nerves.

The tibia is more often involved in tertiary syphilis than any other of the long bones. Caries, necrosis, and exostoses are frequently noted.

The Phalanges.—Syphilitic dactylitis appears in the form of a gummatous deposit, which may involve the subcutaneous connective tissue of the fingers and toes, together with the periosteum and bones of these parts. This involvement appears in a superficial and in a deep form.

In the superficial form there is gummatous infiltration of the subcutaneous tissues, which subsequently involves the ligaments surrounding the joints. If the toes are affected they generally exhibit the lesions through their entire length. In the fingers the hardening and enlargement are commonly limited to a single phalanx.

Syphilitic dactylitis is characterized by a slow, painless swelling, most marked on the dorsal aspect of the finger, and rarely extending farther up than the metacarpo-phalangeal articulation. There is some discoloration of the affected area; the region of the joint becomes swollen, and from softening of its ligaments there results preternatural mobility. These enlargements exhibit an ultimate tendency towards softening and ulceration. Hydrarthrosis is rarely observed.

This form of the disease develops as a late secondary or distinctly tertiary manifestation.

The deep form appears as a specific osteomyelitis and periostitis. It usually involves an entire carpus or tarsus, though it may be confined to the opposing extremities of two phalanges. The proximal phalanges of the fingers are commonly attacked, often several at one time. When the metacarpal bones are also involved, these are generally of the thumb and the index finger.

This form occurs late in the disease, from five to fifteen years after the appearance of chancre. It is chiefly limited to the bones and the periosteum, the integument being seldom involved. Sometimes, however, when the process is rapid and extensive, ulceration, caries, and necrosis result. As the joint becomes involved, the cartilages are eroded and crepitus may be detected. From infiltration of the ligaments and capsule the function of the joint may be seriously interfered with, the latter being sometimes rendered too loose, or, again, from extensive swelling motion being almost entirely prevented. Even when ulceration does not take place there may be shortening or deformity of the bone consequent upon dry caries or interstitial absorption.

Syphilitic dactylitis occurs much more frequently in hereditary than in acquired syphilis. The fingers are less frequently affected than the toes.

SYPHILIS OF THE JOINTS.

Arthralgia.—During the secondary period arthralgia is a common and early manifestation of constitutional disease. This sometimes precedes the eruption, and may be unaccompanied by fever. Pain, which is often much worse at night, is the only symptom. There are no discoverable lesions.

Synovitis may develop at the same time; usually it comes later; it may be either polyarticular or monarticular, or may appear in the form of hydrarthrosis.

Acute polyarticular synovitis is characterized by practically the same pathological changes that are observed, for instance, in polyarticular rheumatism.

Reference to the symptomatology and diagnosis of this affection has already been made. In one or two weeks, especially if specific treatment is instituted, resolution takes place.

Acute monarticular synovitis exhibits the same symptoms as the polyarticular form of the affection, except that the disease is strictly confined to one joint, usually the knee, is intensified, and is much more liable to become chronic. Moreover, it yields slowly to treatment. This monarticular form of trouble sometimes follows the polyarticular involvement, resolution taking place in all but a single joint. Pathological changes are in this case more pronounced.

Hydrarthrosis, or chronic hypertrophic synovitis, pursues practically the same course as chronic synovitis from other causes. There is thickening. The synovial membrane is tufted, and there is a gummatous infiltration extending even to the articular cartilages and the ligaments. There is a marked effusion into the joint, and ultimately it may be rendered useless, either from limitation of motion or from absolute fixation. When there is extensive involvement of the cartilages and bones, osteophytes may form, resulting in partial or complete bony ankylosis.

Gummatous arthritis, a late manifestation of syphilis, is characterized by the development of gumma, primarily of the ligaments or articular cartilages, generally accompanied by the synovial changes encountered in hydrops articuli,—*i.e.*, thickening and tufting of the synovia. In certain cases the nodular gummatous infiltration may be distinctly felt in the general swelling involving the joint.

The amount of serous effusion varies greatly. Either resolution may take place or the joint-cavity may open and suppurate. The joints may be secondarily involved from gummatous or ulcerative processes of the overlying parts, or of the bones entering into their formation.

The joints most frequently involved are the sterno-clavicular and the knee; the elbow, the wrist, and the ankle follow next in order of frequency.

Symptoms.—Gummatous synovitis when it develops first in the capsular synovia causes few symptoms aside from an apparently movable, circumscribed tumor. Exceptionally the whole joint becomes quickly swollen, and there are limitation of motion and rapid muscular atrophy. Ultimately there are more or less fixation and permanent deformity. If the bone is involved in the gummatous process the swelling is usually more marked, the articular extremity of the involved bone becoming distinctly thickened, and muscular atrophy is extremely rapid. The subjective symptoms are often in their mildness out of proportion to the apparent severity of the lesions. With a greatly swollen and inflamed knee-joint the patient may be able to walk with comparative ease and comfort. If, however, the cartilage has been eroded there may be total disability, and in any event there is likely to be more or less pain, particularly severe at night.

Diagnosis.—The comparative rarity of syphilitic joint affections and their similarity to tuberculous involvement often lead to an incorrect diagnosis and to the needless loss or sacrifice of an articulation. This is particularly true of the knee-joint. Syphilitic synovitis presents no clinical feature in its course by which it can be distinguished from other forms of synovitis. The tuberculin and therapeutic tests should be employed in all doubtful cases. In the acute forms of the affection the absence of heart-lesions and failure of antirheumatic remedies may suggest the true nature of the synovitis.

Chronic syphilitic hydrarthrosis, in the absence of a history of other signs or symptoms of syphilis, cannot be distinguished from tubercular synovitis except by the tuberculin and therapeutic tests. Under the use of mercury and potassium iodide enormous effusions may slowly disappear.

Gummatous arthritis and synovitis can be positively diagnosed only by the evidence offered by other lesions of syphilis, such as ulcerating gummata of the skin. Tubercular arthritis differs from the gummatous in the fact that it is often, though not necessarily, associated with characteristic tuberculous lesions elsewhere, that it is more prone to ulcerate and open externally, and that it produces more rapid and extensive destruction of the bone.

Prognosis.—The prognosis of syphilitic joint disease is comparatively good when the affection develops early in the course of syphilis and is recognized and promptly treated. Later, atrophic changes, or those due to infection, produce permanent deformity and disability. The synovitis yields readily to specific treatment. Arthritis, even though cartilages and joints are extensively involved and there are contraction and deformity, is also curable by constitutional treatment, reinforced in cases characterized by abscess formation and bone necrosis by sequestrectomy, partial arthrectomy, or other surgical procedure. Even when total arthrectomy is required, provided the nature of the disease has been recognized, the prognosis is infinitely better than if the joint disease has been due to causes other than syphilis.

Treatment.—The treatment of syphilitic joints consists in the administration of mercury and potassium iodide, except in the forms occurring in the beginning of the secondary period, when mercury alone should be given. The local treatment is the same as that appropriate to other forms of non-suppurative arthritis. Rest and pressure procured by splints and bandages, counter-irritation, and in later stages massage are indicated.

Bursitis.—The bursæ may become acutely inflamed, exhibiting the characteristic symptoms of this affection. This is extremely rare.

Much more common, though still rarely encountered, is gummatous bursitis, usually observed in the prepatellar bursa, appearing in the form of a nodular, painless, fluctuating swelling, which is prone to soften and break down.

SYPHILIS OF THE MUSCLES.

Acute irritative myositis develops very exceptionally during the first year of secondary syphilis. The symptoms are identical with those of a muscular rheumatism which is slow in onset and somewhat chronic in type.

There is dull pain, aggravated by pressure or motion. Sometimes this is exceedingly severe. The biceps and triceps are most frequently involved. They sometimes exhibit irritative contraction seriously interfering with the motion of the part and controlled only by constitutional treatment.

The symptoms yield readily to vigorous mercurial treatment.

Tertiary syphilis may attack the muscles in the form of—

1. Chronic interstitial myositis.
2. Gummatous myositis.

Chronic interstitial myositis begins as a cellular infiltration of the muscular fibres; the infiltrate subsequently becomes organized into connective tissue, resulting in muscular contractures and atrophy.

The pathological changes are most marked in the bellies of the muscles; the anal sphincter and the humeral biceps are most frequently involved, though contractions of the sterno-cleido-mastoid, pectoralis major, rectus abdominalis, masseter, and many other muscles have been noted.

Symptoms.—There are, in addition to severe pain, slight tenderness, limitation of motion, and diffuse swelling. As the disease progresses the muscle atrophies and shortens.

Diagnosis.—Chronic syphilitic myositis when unaccompanied by other and more characteristic signs of syphilis may imitate muscular rheumatism. The syphilitic affection is, however, unattended by constitutional symptoms or joint-involvement. It develops without apparent cause. It is slowly and persistently progressive, and is shortly accompanied by contracture. Moreover, it exhibits marked predilection for certain muscles. In all these points it differs from muscular rheumatism. The therapeutic test should positively decide the matter.

Gummatous myositis differs from the interstitial infiltration only in the facts that it is circumscribed, forms a distinct tumor, often involves neighboring parts, and exhibits a tendency to degenerate, soften, and discharge.

Gummata of muscle are usually late manifestations of syphilis; in the malignant forms of the disease these may develop in the first year, and under such circumstances are apt to suppurate.

Symptoms.—Usually gummata develop as painless, slowly growing tumors, seated at the point of insertion of the muscle or in its belly, movable with the latter, but fixed when it is strongly contracted; exceptionally, when infiltration is rapid, there may be great pain and tenderness. The tumor usually reaches the size of a man's fist. Sometimes it grows to the size of a child's head; it may then simulate malignant disease so closely that the therapeutic test alone will enable a diagnosis to be made. These gummata are absorbed, soften, or become converted into dense fibroid masses. The trapezius, pectoralis major, gluteus, biceps, and lingual muscles are oftenest affected.

Prognosis.—Diffuse interstitial myositis and muscular gummata if treated early yield completely to iodides and mercury; later, when the muscular fibres have atrophied and cicatricial contractions have occurred, constitutional treatment is unavailing, except to prevent further extension of the syphilitic process.

Syphilitic tenosynovitis may appear in the acute, the chronic, or the gummatous form.

ACUTE TENOSYNOVITIS may develop in the early secondary period, and is characterized by effusion, tenderness, and swelling along the course of the tendon. It subsides quickly under specific treatment. Several tendons may be affected simultaneously, and there may be great pain and tenderness, and an associated syphilitic synovitis with fever. The affection is more common in women than in men.

CHRONIC TENOSYNOVITIS.—Rarely, chronic tenosynovitis develops, characterized by effusion and crepitation along the course of the tendon. It is accompanied by some thickening of the sheath, especially observed about the extensor tendons of the fingers and toes and the biceps tendon.

Chronic syphilitic tenosynovitis is usually painless and yields slowly to constitutional treatment. It presents the same symptoms as the non-specific inflammations of the tendon-sheaths.

GUMMATOUS TENOSYNOVITIS.—Gummata sometimes develop in the sheath of the tendon. These are painless, and are either round or spindle-shaped. Exceptionally the gumma appears in the form of a diffuse infiltration. These gummata subside promptly under specific treatment. They are most frequently found on the tendo Achillis and the biceps tendon. The diagnosis is usually facilitated by the presence of gummata elsewhere, particularly in the muscles. In the absence of these or other signs of syphilis, a trial of specific treatment should be instituted. The development of the gumma usually distinguishes it from other tumors, enchondroma, for instance, since sooner or later, in the absence of specific treatment, the gumma softens and breaks down, forming a characteristic ulcer.

SYPHILIS OF THE CIRCULATORY SYSTEM.

Heart.—Syphilitic involvement of the heart is exceedingly rare. It usually appears as a late tertiary manifestation, according to Jullien, about the tenth year after the infecting chancre, though it may develop in the first year of constitutional syphilis. The disease appears as a diffuse chronic myocarditis or in the form of gummata.

SYPHILITIC MYOCARDITIS.—Fusiform areas of small round-celled infiltration of the heart-muscle first appear; these become converted into connective tissue and form thick, white cicatrices. The cicatrices are usually few in number, and are found in the walls of the left ventricle, frequently lying just below the endocardium or pericardium.

GUMMATOUS MYOCARDITIS develops in the form of tumors, varying from the size of a pea to that of a pigeon's egg. These tumors present the same appearance as gummata in other regions; that is, there is a central caseous mass, surrounded by a thick, fibrous sheath, in the periphery of which the muscular fibres are in a condition of fatty degeneration.

ENDOCARDITIS AND PERICARDITIS.—Syphilitic inflammation of the membranes of the heart is rarely primary. It is commonly found about the regions where gummata or patches of chronic myocarditis have developed. When the endocardium of the valves is attacked, insufficiency may result from cicatricial contraction.

Symptoms.—The symptoms of syphilitic involvement of the heart or its envelopes are exceedingly vague. Generally the affection is not detected until it is so far advanced that treatment offers little prospect of cure. Sometimes patients complain of shortness of breath, palpitation, anginose pains, or irregularity of the pulse. At the same time examination of the heart shows an increased area of dulness, some muffling of the sounds, and frequently blowing murmurs, the exact cause and location of which it is difficult to discover.

In all these symptoms there is nothing characteristic. The diagnosis can be made only by exclusion and by eliciting a history of preceding syphilis.

Prognosis.—This must always be guarded. The disease passes through its various phases so slowly and with so few symptoms that it is rarely suspected until cicatrices have formed. In a large number of the reported cases death has been sudden and unexpected. In three cases death occurred during defecation.

Treatment.—The treatment consists in the administration of potassium iodide, the doses being rapidly pushed to the extreme limit of toleration. At the same time remedies appropriate to the functional troubles, as evidenced by the clinical symptoms, should be given.

Arteries.—Syphilitic involvement of the arteries is generally a tertiary lesion, but has been observed in the first few months of the constitutional disease.

Syphilitic arteritis may be acute or chronic in type. In either case the pathology is much the same. There is at first a cellular infiltration, usually beginning as a periarteritis and involving all the coats of the vessel, causing its walls to become irregularly thick, hard, and non-elastic, and narrowing or quite obliterating the blood-channel. Even should the infiltration not mechanically close the vessel lumen, as a result of endarteritis, thrombi frequently form, thus preventing circulation through the diseased area.

Endarteritis may be of the sclerous or of the gummatous type.

SCLEROUS ENDARTERITIS is the commonest form of the affection. The infiltrate is converted into fibrous tissue, producing whitish, opaque patches of hardening, which may appear as disseminated plaques or as small nodulations, usually involving the entire circumference of the vessel.

GUMMATOUS ENDARTERITIS is extremely rare; it is always associated with the sclerous degeneration and with periarteritis, and on section shows the broken-down, cheesy contents of the typical gumma.

Syphilitic arteritis affects usually the smaller arteries, and *particularly those of the brain.* By weakening the vessel-walls and by increasing the blood-pressure from local obstruction to circulation the disease strongly predisposes to the formation of aneurism.

Symptoms.—The symptoms of syphilitic arteritis depend upon the disturbances of function incident to the ischæmia which follows narrowing or obliteration of the arterial lumen. When collateral circulation is readily established, but little functional disturbance may result from obstruction of one or more vessels. When there is no provision for collateral circulation, however, as in the areas supplied by smaller cerebral arteries,—and it is these that are most frequently implicated in syphilitic arteritis,—functional disturbances may be pronounced.

Cerebral ischæmia from syphilitic arteritis is characterized by frontal headache, followed in weeks or months by epileptiform attacks, hebetude, somnolence, hemiplegia, particularly marked in the upper extremity, usually attacking the right side, accompanied by aphasia, and sometimes coming on without loss of consciousness, and finally by coma and death.

When in consequence of syphilitic arteritis aneurism develops, beyond a history of syphilis and the presence of other manifestations of the disease there are no diagnostic signs which would point to the nature of the lesion. These aneurisms form mostly in the brain, and produce much the same functional disturbances as have been described as attendant on sclerous arteritis.

Occasionally the larger vessels are involved. Cases of aortic aneurism almost certainly originating in syphilitic changes in the walls of the great vessels have been reported.

Prognosis.—The prognosis of syphilitic arteritis is bad. This is because symptoms rarely develop till sclerosis is well advanced, and particularly in the case of the brain, because the alterations in the nerve-structure are often irremediable. Aneurisms occasionally yield to constitutional treatment, and angina may promptly disappear after a course of potassium iodide and mercury, never to recur.

Veins.—The veins rarely exhibit syphilitic lesions. Mauriac instances a single case of phlebitis and thrombosis involving several vessels and occurring in the first few months of constitutional syphilis.

Phlebitis in secondary syphilis is characterized by superficial localization, multiplicity of veins involved, absence of embolism or serious complications, and recovery under specific treatment.

SYPHILIS OF THE LYMPHATIC SYSTEM.

While primary and secondary syphilis produce almost invariably marked effects upon the lymphatic glands, the tertiary form of the disease manifests itself in the lymphatic system with comparative rarity.

The surface glands are much more rarely involved than are those in the neighborhood of viscera. Of the deep glands, post-mortem examinations have shown that those ordinarily involved are the bronchial, the pulmonary, the mediastinal, the hepatic, and the gastric.

The superficial glands most frequently affected are those in the supraclavicular, intraclavicular. cervical, inguinal, and axillary regions. Patients of a scrofulous temperament are most subject to these enlargements.

The sclerous and gummatous types are recognized. Both are characterized by primary enlargement incident to hypertrophy and cell proliferation. The tumor formed is at first regular in outline, smooth, freely movable beneath the skin, and indurated.

Enlargement of a single gland is rare. Usually a whole group of glands in one region of the body is involved. The tumors vary from the size of a cherry to that of a man's fist. Usually they are no larger than a hickory-nut. Having reached this stage, the tumors may slowly undergo resolution, taking sometimes months or even years to accomplish this; or exceptionally they may continue to enlarge, becoming soft, adhering to the skin, and ulcerating, discharging thick, yellowish pus containing shreds of necrotic tissue. The small opening at first formed becomes rapidly large, with indurated, ragged edges surrounded by a brownish-red area of congestion.

Exuberant granulations may be formed, resulting in fungoid growths.

Specific treatment and local applications cause rapid healing of these ulcers. There remains a deep, irregular, pigmented scar. Occasionally these ulcerating syphilitic lymphomata become phagedenic, exposing the patient to the dangers incident to this form of inflammation.

Diagnosis.—The diagnosis of syphilitic lymphomata is often exceedingly difficult, and can be established only by careful attention to the history of the case.

Syphilitic adenopathy may closely simulate tubercular adenitis. The latter, however, is usually observed in infants, or at least during early adult life; is accompanied by other evidences of a tubercular diathesis; attacks by preference the cervical and submaxillary glands; is more generalized, and forms larger tumors; commonly exhibits suppurative periadenitis with formation of fistulous tracts not distinctly ulcerative in type; does not become phagedenic, and is not improved by specific treatment. Cancerous adenopathy is nearly always secondary. The tumor grows rapidly, becomes adherent to surrounding tissues, ulcerates, bleeds, and progresses in spite of treatment, producing profound cachexia.

Prognosis.—Except in cases where general ulcerating lymphomata become phagedenic, the prognosis is exceedingly good.

Treatment.—Early treatment nearly always occasions prompt resolution. Both potassium iodide and mercury should be given, the former drug in full doses, the latter internally, and locally in the form of inunctions. Even when distinct fluctuation is noted, the knife may not be necessary.

Local counter-irritation and the administration of tonic and supporting treatment will hasten resolution.

Ulcerating gummata of the lymphatic glands are exceedingly rare. The treatment is that of other tertiary lesions.

SYPHILIS OF THE LIVER.

The liver may be affected in both the secondary and the tertiary period of syphilis. Involvement in the secondary period is exceedingly rare; tertiary lesions, however, affect the liver more frequently than they do any other abdominal organ.

Precocious syphilis of the liver appears in the first three months of the constitutional disease as hypertrophy, which may or may not be accompanied by pain, tenderness, and jaundice. The hypertrophy is general, and may enlarge the liver to twice its normal size. On palpation no nodules are found, simply a general increase in size. The prognosis is good, the enlargement gradually diminishing under constitutional treatment, till in from one to three months the liver is again normal in size.

Jaundice developing during the secondary period is rarely due to syphilis. The great majority of such cases, when unattended by hepatic enlargement, are caused by intercurrent affections, such as a catarrhal condition of the bile-ducts, and are neither directly nor indirectly dependent upon constitutional syphilis. Calvert has, however, collected one hundred and twenty-seven cases of jaundice occurring as a manifestation of secondary syphilis, and notes that it is rapid in appearance, varies greatly in intensity, recurs, and is not associated with grave digestive disturbances. Icterus gravis is most exceptional. The diagnosis is based on the history and associated symptoms of syphilis and upon the rapid improvement under specific treatment.

Tertiary syphilis of the liver may appear as interstitial hepatitis or as gummatous hepatitis. These tertiary lesions are in marked contrast to the secondary involvement of the liver from the fact that they rarely appear till late in the disease, from the fourth to the fortieth year. They are frequent, they are persistent and rebellious to treatment, and they produce permanent alteration in the liver-substance.

The abuse of alcohol, traumatism, and carelessness in treatment seem to be the factors which particularly predispose the liver to tertiary manifestations of syphilis.

INTERSTITIAL HEPATITIS (diffuse gummatous infiltration).—This runs very much the course of an ordinary cirrhosis. It begins as a hyperæmia, accompanied by an abundant small round-celled infiltration of the perivascular connective tissue of the liver. This cellular hyperplasia generally appears in disseminated patches of perihepatitis, resulting in adhesions to surrounding organs. The infiltration of the substance of the liver may be general, though it is commonly found in patches. The cellular infiltrate becomes, in part at least, converted into connective tissue, which by its contraction causes narrowing and obliteration of ducts and vessels and atrophy of liver-cells. There is at first an increase in the size of the liver, general or localized, depending upon whether hyperæmia and cellular infiltrates are diffuse or appear in discrete patches. Ultimately, as the round-celled infiltrate in part undergoes fatty degeneration and is absorbed, in part becomes converted into connective tissue and contracts, the enlarged liver becomes smaller; but this lessening in size does not stop when the organ has reached its normal dimensions; the atrophic process steadily advances; the surface of the organ is lobulated, is marked by deep furrows, is creased by dense fibrous bands, and the liver is distorted almost beyond recognition. The contraction of the fibrous bands is often so pronounced that some of the lobulations thus produced are almost completely cut off from the rest of the liver, seeming to be attached only by the fibrous tissue surrounding the base.

Together with atrophy in one portion of the liver there may be overgrowth in another. This may be due to amyloid degeneration or to compensatory hypertrophy, the intact portion of the liver-substance developing so that it may take the place of the portion destroyed.

The furrowing and lobulation are usually much more distinctly marked upon the convex than upon the concave surface of the organ.

GUMMATOUS HEPATITIS is characterized by the formation of gummata identical in structure with similar tumors observed in other portions of the body. These tumors vary from the size of a pea to that of a hen's egg; they are most frequently found in the region of the suspensory ligament and along the course of the portal vein, though they may appear in any part of the liver; they may be grouped or irregularly disseminated. They are gray or yellowish in color, and either solid throughout or broken down in the centre, according to the period of evolution.

As the gummata soften centrally, undergoing fatty and caseous degeneration and becoming absorbed, the peripheral portion of the neoplasm is converted into fibrous tissue, which contracting produces on the surface of the liver deep irregular puckerings, sometimes so marked as seemingly to divide the right lobe of the liver into two halves. In the deeper portion of the liver irregular branching nodules are formed, in the centre of which is sometimes found a small amount of caseous material.

There is nearly always associated with these gumma a perihepatitis, resulting in adhesions between the liver and surrounding structures; this is particularly marked on the upper surface, and may so limit the respiratory movements of the organ as to constitute a sign of some diagnostic value. Interstitial hepatitis and amyloid degeneration of the liver, spleen, kidneys, and intestinal mucous membrane are also frequently noted in connection with old gummata.

The gummata of the liver do not ulcerate; they develop slowly, and may not reach their ultimate stage of cicatrization for several years.

Symptoms.—The symptoms of syphilitic interstitial hepatitis are rarely well marked. In the early stage there is a feeling of weight in the hepatic region, followed, often after a long period, by hypertrophy, slow in development, and unattended by signs of inflammation. Sometimes the hypertrophy is general, the lower border of the liver extending three finger-breadths below the margin of the ribs, and revealing to palpation a smooth, regular surface. Often the hypertrophy is not so marked, palpation showing surface irregularities or elevations. It is dependent upon compression of the portal vein from perivascular hyperplasia.

Functional disturbances are limited to general dyspeptic symptoms, even these not being noted at times. As the disease progresses and atrophy sets in, the only sign which may be considered characteristic is the deformity incident to cicatricial contraction. A nodular surface, an irregular fissured border, gradually becoming less perceptible to palpation in one portion while overgrowth is observed in another region, and adhesions to surrounding structures, are all signs which would suggest syphilis.

Icterus is comparatively rare; hæmatemesis, diarrhœa, digestive troubles, and swelling of the legs develop as in the case of cirrhosis from causes other than syphilis.

Ascites is frequently noted; fluid accumulates slowly in the first place, but on tapping reaccumulates rapidly. Often there are no premonitory symptoms; a painless ascites gradually develops, associated with jaundice, discolored urine, swelling of the ankles, varicose veins, and possibly albuminuria.

Gummatous hepatitis in the early stages may give rise to no symptoms, and may not seriously interfere with the functions of the liver. As the disease progresses, the accompanying hepatitis, perihepatitis, and amyloid degeneration cause most of the suffering and interference with general health. The liver is usually of normal size, presenting to the examining finger a nodular irregular border. Gastro-intestinal symptoms are marked, pain may be severe and constant, and, when the atrophic process is well developed, bleeding from the stomach or from the œsophagus may become a serious complication.

Enlargement of the spleen and albuminuria are commonly associated with specific hepatitis. As a consequence of this involvement of the liver, spleen, and kidneys, pronounced cachexia ensues.

Prognosis.—The prognosis of tertiary syphilis of the liver is, if the affection is taken in its earlier stages, fairly good. The gummatous form yields more readily to specific treatment than the diffuse or cirrhotic form. When extensive fibroid changes have taken place, and particularly when there are associated lesions of the kidneys and spleen and marked cachexia, the prognosis must be exceedingly guarded.

Diagnosis.—The diagnosis of liver syphilis is founded upon alterations in the size and shape of the liver, associated with much milder symptoms than are attendant on such alterations when they are due to other causes. There is usually a history of syphilis; digestive troubles are not very pronounced, or, if marked, do not develop till late in the disease; serous effusion into the peritoneal cavity is moderate in quantity, but is quickly reproduced after having been evacuated. These features will aid in distinguishing the ordinary cirrhotic liver from that affected by syphilitic diffuse interstitial hepatitis.

Gummatous hepatitis may simulate cancer. The latter affection, however, occurs in those past middle age, involves both lobes of the liver, and is rarely primary. It is not so liable to contract adhesions as are gummata: hence its nodulations are more readily felt; it is accompanied by pain and jaundice, and produces early and profound cachexia; it grows much more rapidly than gumma, and associated enlargement of the spleen is rare.

Treatment.—All forms of hepatic syphilis occurring in the early secondary period should be treated by mercury.

In the form generally observed—that is, as a late tertiary manifestation—potassium iodide should be administered in large doses, beginning with thirty grains a day and running the dose up by five grains a day till the symptoms yield or iodism is produced. The dose required is sometimes as high as two or three drachms daily.

In addition to the potassium iodide, mercurial inunctions should be given at intervals. Tonics, mild stimulation, bathing, exercise, diet, and general hygiene must receive careful consideration.

AMYLOID DEGENERATION is so frequently associated with syphilis that the latter must be recognized as an etiological factor in its production. As when it complicates tuberculosis, it may follow extensive suppurative processes. It is also found, however, in conjunction with the sclerotic or the gummatous form of hepatitis, and is commonly complicated by a similar affection of the spleen, the kidneys, and often the intestinal mucous membrane. The liver rarely reaches the enormous size sometimes observed in amyloid degeneration from other causes.

In itself amyloid degeneration does not cause ascites, and gives rise to no functional disturbances until it is far advanced. Ultimately digestive disturbances become pronounced, and, as the result of similar degeneration of the intestinal mucosa, multiple ulcers develop, causing blood-stained stools. There is usually œdema, and, if the kidneys are also involved, albuminuria. Cachexia is well marked.

The diagnosis is based on finding an enlarged, smooth, firm, non-sensitive liver, together with other signs of late syphilis. In amyloid degeneration with gummatous or sclerotic processes the liver may be ridged, notched, or otherwise deformed.

The prognosis is extremely grave. The treatment is that appropriate to late syphilis, combined with tonics, stimulants, carefully regulated diet, and minute attention to general hygiene.

SYPHILIS OF THE SPLEEN.

The spleen, closely associated as it is with the lymphatic system of the body, is frequently affected in secondary syphilis. There is a distinct enlargement, usually occurring early, but sometimes not for several months. This enlargement is not followed by functional troubles. There is nothing to call the patient's attention to the swelling, and it is rarely observed unless careful search is made for it. It commonly subsides in the course of a few weeks or months. The pathology is probably the same as that of the lymphatic glandular enlargement of secondary syphilis.

Tertiary syphilis may produce gummata or disseminated or localized splenitis, resulting ultimately in partial cirrhosis. These lesions rarely betray themselves in life by appreciable symptoms. It is only as the result of post-mortem examination that their existence has been proved.

They may be suspected when physical examination shows increase in the volume and consistence of the spleen and when deep pressure elicits tenderness. They are nearly always associated with similar lesions of the liver and kidneys, the symptoms of which completely mask splenitis.

Pronounced leucocytosis and the finding of pigmented masses in the blood may suggest involvement of the spleen.

SYPHILIS OF THE PANCREAS.

Specific disease of this organ may take the form of interstitial pancreatitis or of gummatous involvement.

These lesions are exceedingly rare. Their presence is not indicated by characteristic symptoms during life. There is usually marked involvement of other abdominal organs.

SYPHILIS OF THE URO-GENITAL SYSTEM.

The Kidneys.—The kidneys are less frequently involved in the lesions of syphilis than are the genitals, the nervous system, or the liver. They may be attacked at any time during the course of the constitutional disease, the lesions produced, with the exception of gummata, being identical with those which characterize Bright's disease in all its varieties.

As etiological factors, tuberculosis, rheumatism, gout, and alcoholism are all of some importance, but the direct exciting cause is either the syphilitic virus or the irritating toxins produced by it in the body and probably excreted through the kidney epithelium.

PRECOCIOUS INVOLVEMENT of the kidney often closely follows the chancre, and is manifested by albuminuria, usually intermittent, transitory, and moderate. The total quantity of urine passed daily is not diminished, nor is the specific gravity markedly affected. Microscopic examination at most may show a few hyaline casts. This albuminuria develops during the early eruptive period and subsides promptly under treatment.

ACUTE SYPHILITIC PARENCHYMATOUS NEPHRITIS is characterized by lesions of the glandular part of the organ, producing a condition analogous to that termed large white kidney. It is in reality a parenchymatous nephritis, and differs in no way from this acute or subacute form of Bright's disease, presenting the same complications and sometimes terminating fatally.

Albuminuria, granular epithelial and blood casts, lessened secretion of urine, headache, œdema, and other symptoms and signs of acute nephritis, are present.

The diagnosis is founded on examination of the urine, the acute rapid course of the affection, the associated symptoms of syphilis, and the therapeutic test.

The prognosis is favorable. If parenchymatous nephritis develops in late syphilis and is associated with gummatous infiltration or amyloid degeneration of other viscera, the chances of cure are slight.

Specific treatment is, however, usually curative, although the albuminuria sometimes persists and the nephritis becomes chronic.

The more profound kidney degenerations characteristic of tertiary syphilis, but sometimes occurring in the late secondary period, are syphilitic interstitial nephritis and gummatous nephritis.

SYPHILITIC INTERSTITAL NEPHRITIS presents the same pathology and lesions as the non-specific form of the disease. The symptoms are those of chronic Bright's disease. This affection is more grave than the early nephropathy. Indeed, after fibrous tissue has once fairly developed, complete restoration of the kidney to its normal condition is impossible.

There is first a cellular infiltration of the interstitial stroma and of the walls of the vessels and perivascular spaces. This infiltration is followed by sclerosis, causing atrophy and distortion of the kidney, particularly noticeable in the cortex.

The symptoms of specific interstitial nephritis are the same as those of the non-syphilitic affection. There are polyuria, lowered specific gravity, light straw color of the urine, moderate amount of albumen, hyaline and granular casts, increased arterial tension, œdema, headache, asthma,—indeed, all the well-known symptoms of chronic nephritis.

The diagnosis as to the specific nature of the affection can be made only by finding other signs or symptoms of syphilis.

The prognosis is unfavorable.

GUMMATOUS NEPHRITIS is rare. The individual tumors rarely reach large size. Cornil states that they are usually multiple and are found chiefly in the cortical substance or in the pyramids. Interstitial nephritis is nearly always found in conjunction with them.

Jaccoud states that amyloid degeneration is by far the most common manifestation of renal syphilis. Next in order of frequency comes granular atrophy; third, gumma.

Wagner describes a fourth form, which he calls syphilitic glomerulo-nephritis. It is characterized chiefly by hæmaturia and ends rapidly in uræmia.

There have been a number of carefully studied cases of diabetes insipidus of syphilitic origin: at least the prompt yielding of symptoms to specific treatment suggested the syphilitic nature of the affection.

The *treatment* of the tertiary kidney-lesions is conducted on the same general principles as would apply to cases of chronic Bright's disease. Mercury must be administered cautiously, since on account of the crippled condition of the kidneys it is extremely liable to produce toxic symptoms. Potassium iodide is the drug upon which main reliance should be placed. It must be given in full doses.

Amyloid degeneration of the kidney is associated with one or more of the forms of syphilitic nephritis. Similar degenerations of other organs, notably the liver and the spleen, are present, and occasion profound cachexia. There are no characteristic symptoms. The prognosis is bad.

The Ureters and the Bladder.—Syphilitic involvement of the ureters and the bladder, so far as symptoms are concerned, is practically unknown. Some few cases of ulceration of the bladder have been described. (See page 436.)

The Epididymis and Testicles.—The syphilitic virus may manifest its influence upon these organs either in the form of interstitial inflammation characterized by infiltration, formation of connective tissue, and atrophy, or in that of gummata.

As clinically observed, syphilitic lesion of the testicle appears as a combination of the forms just mentioned. Both epididymis and testicle may be involved, the sclerous and gummatous processes going hand in hand. There is often an accompanying hydrocele. The lesions may be observed at almost any period of syphilis from the second month to the twentieth year.

Syphilitic Epididymitis.—The epididymis when involved commonly presents an indolent, non-inflammatory, indurated, sharply circumscribed gumma, usually of the right globus major. Both epididymes may be affected simultaneously.

Involvement of the epididymis without implication of the testicle is rare. It usually develops towards the end of the secondary period of the disease. It may be observed at any time during the secondary eruptions, and at this period undergoes prompt resolution on treatment, since, like all the secondary lesions, it has no marked tendency towards sclerosis or caseous degeneration.

When it develops in the late tertiary period it corresponds more closely to the type of the tertiary lesions,—that is, it tends to break down and ulcerate. This occurrence is much rarer, however, than is the case with tubercular lesions.

The enlargement never attains great size. There are rarely more than two nodules, which after some months become of almost cartilaginous hardness. Exceptionally there may be a number of small nodules, grouped at either extremity of the epididymis, the middle portion being spared.

Sometimes this affection may be acute in its onset and accompanied by inflammatory symptoms. On examination, however, a rounded tumor at the head of the epididymis, or at both the head and the tail, with slightly irregular surface, not adherent to the surrounding tissues, probably circumscribed, and without fusion into the tunica vaginalis, suggests the nature of the lesion.

Diagnosis.—The diagnosis of syphiloma of the epididymis is readily made. The absence of pain, of tenderness, of involvement of the skin, and of hydrocele, together with the infiltration of the head of the epididymis rather than of the tail, would exclude gonorrhœal epididymitis.

From tubercular epididymitis a differential diagnosis based upon the local symptoms alone may be difficult. The tubercular infiltrate usually involves the caput major, producing a hard, painless induration much like that characteristic of syphilis. This steadily grows larger, presents a more irregular and nodulated surface than does the syphiloma, becomes adherent to the skin of the scrotum, softens, and discharges, forming fistulæ. Tubercle bacilli can be demonstrated in the discharge by inoculation. The cord becomes indurated, and the seminal vesicles and prostate are usually involved

Treatment.—Mixed treatment is indicated.

Syphilitic Orchitis.—After the skin and subcutaneous tissues and the bones, the testicle is the most frequent seat of tertiary syphilis. This organ may be involved in the early months of the secondary period; usually the third year is the time during which tertiary symptoms develop.

The affection may assume the sclerous or gummatous form, though it must always be recognized that these two processes run their courses side by side, and that, while the predominant lesion may appear as a cellular infiltration of the albuginea and its trabeculæ followed by cicatricial contraction, an examination of the diseased testicle shows the presence of small or large gummata. *Per contra*, even though the affection appears to be entirely gummatous, it is always associated with a greater or less degree of interstitial orchitis. Whether the lesion conforms to the sclerous or to the gummatous type, its onset is insidious, and it is often bilateral. Its course is exceedingly chronic, and it terminates in (1) resolution, (2) partial or complete atrophy, or (3) destruction by ulceration.

The most important predisposing cause of syphilitic sarcocele is gonorrhœal epididymitis; traumatism or sexual excesses may also lessen local resistance.

INTERSTITIAL OR SCLEROUS ORCHITIS is the common form of syphilitic sarcocele. It may be unilateral or bilateral. Beyond a sense of weight and enlargement, its onset is characterized by no subjective symptoms.

The testicle enlarges uniformly to two or three times its normal bulk. It forms an indurated, non-sensitive tumor. The epididymis is flattened along its posterior border, so that it becomes difficult to recognize it on palpation. The cord is rarely involved. The surface of the tumor is usually smooth, though it may be nodular or ridged. Testicular sensation on pressure is lost.

The tumor forms slowly, requiring weeks or months for its complete evolution. It may remain stationary for months, and finally subside, leaving an apparently normal testicle, or, in place of resolution, there may be sclerogenesis and complete atrophy, the testicle disappearing and the vas terminating in a fibrous nodule.

It is to be noted that even though both testicles are involved there is not necessarily either impotence or sterility, since the infiltration generally spares some of the secreting portion of the gland.

ACUTE SYPHILITIC ORCHITIS.—Exceptionally this sclerous orchitis may depart from its ordinary type and the symptoms may become so acute as entirely to obscure the diagnosis. In this form of the disease the testicle rapidly swells, and becomes exceedingly sensitive; the scrotum is reddened and œdematous, and there is violent and constant pain.

Commonly but one testicle is affected. Acute symptoms last but a few days. The inflammation comes on without exciting cause, rarely presents symptoms as acute as those of an inflammatory orchitis, and is distinguished from gonorrhœal epididymitis by the fact that the testicle is primarily enlarged and presents the same form and density as are observed in the ordinary syphilitic sarcocele.

As a rule, the tunica vaginalis is not affected in syphilitic sarcocele, or there is but moderate serous effusion. This is sometimes circumscribed, and may assume a pseudo-membranous form. Exceptionally the effusion is so great as to prevent palpation of the testicle.

GUMMATOUS ORCHITIS.—The development of gummata is often preceded by the sclerous type of syphilis of the testicle, though frequently the affection is distinctly gummatous from its onset. In place of the general enlargement, or rather accompanying this, distinct nodules, ridges, or tumors appear, usually on the anterior surface of the testicle. These tumors increase in size. The tunica vaginalis becomes adherent; the overlying skin of the scrotum is infiltrated and reddened, and finally softening and ulceration take place, with evacuation of broken-down granulation-tissue and gummy pus. The resulting punched-out hollow ulcer has dusky indurated borders, and communicates with a ragged, irregular cavity containing gray unhealthy granulations. The scar left after healing is adherent to the testicle.

At times the granulation-tissue slightly proliferates, and forms a cauliflower growth projecting externally and overlapping the seat of skin perforation; this is known as a benign syphilitic fungus.

There are two varieties of syphilitic fungus,—the superficial and the deep. Both originate from ulcerating gummata. The superficial fungus starts from gumma of the scrotal tissues or of the tunica albuginea. A superficial form which is almost identical and is more common is due to tubercle.

Parenchymatous or deep fungus is usually syphilitic. It arises from gumma of the testicle proper. The granulations grow upward through the albuginea and the tissues of the scrotum. At times portions of the seminiferous tubules will be found in the discharge.

Softening and ulceration do not always take place. As in the case of interstitial orchitis, gumma may spontaneously, or from the effect of treatment, undergo resolution, leaving the testicle apparently as healthy as before the attack, or crippled and deformed by cicatricial contraction.

Diagnosis.—The diagnosis of sarcocele in its typical form is not difficult. This affection commonly develops when other unmistakable manifestations of syphilis are present. The tubercle bacillus and the gonococcus when they invade the testicle attack the epididymis primarily; tubercle commonly invades the cord, the seminal vesicles, and the prostate. Syphilis, however, hardly ever attacks the cord.

Finally, the effect of constitutional treatment will be found a valuable means of clearing the diagnosis.

The differential diagnosis between syphilitic sarcocele and that due to carcinoma or tubercle may be tabulated as follows:

Syphilitic Orchitis.	*Encephaloid Carcinoma of Testicle.*	*Tubercular Orchitis.*
Syphilitic history.	No history of any special condition.	Tubercular history.
Usually occurs at about twenty-five or thirty years of age.	Occurs at any age.	Not often seen after thirty.
Begins in the testicle.	Begins in the body of the organ.	Begins in the epididymis.
Is situated primarily in the connective tissue.	Begins by the deposit of small nodules in the seminiferous tubules.	Exists primarily in the tubules.
Tends to fibrous overgrowth.	Tends to formation of patches of softened, white, pultaceous material.	Tends to fatty, caseous, or purulent degeneration.
Slow in its progress.	Rapid in its course.	Slow in its progress.
Skin of the scrotum rarely involved.	Skin of the scrotum finally involved.	Skin involved only just before the formation of abscess.

Syphilitic Orchitis.	*Encephaloid Carcinoma of Testicle.*	*Tubercular Orchitis.*
Ulceration or suppuration rare.	Ulceration and fungus common.	Suppuration common.
Fistulæ rare.	Fistulæ common.	Fistulæ common.
A feeling of great weight, with only such pain as results from dragging on the cord.	Pain severe and lancinating in advanced stages.	Little pain.
Tumor very hard and uniform.	Soft and fluctuating.	At first hard, knotty, irregular.
Skin of scrotum purplish, but unaffected.	Net-work of large veins over surface of tumor.	Skin congested, but otherwise unaffected.
Testicle of moderate size; rarely exceeds twice its normal diameter.	Attains great size.	Of moderate size.
Painless on pressure.	Painless on pressure.	Often painful on pressure.
Both testicles often affected.	Generally only one testicle affected.	Often both testicles affected.
Fungus rare.	Fungus always present in advanced stages.	Fungus common.
No discharge or bleeding.	Bleeds freely; offensive discharge.	Less apt to bleed; discharge less offensive.
Lasts many years.	Rarely extends beyond twenty months.	Lasts several years.
Curable.	Usually fatal.	Generally incurable.
No involvement of inguinal glands, as a rule.	Inguinal, iliac, and lumbar glands and cord affected.	Usually no inflammation of glands.

Lymphadenoma sometimes almost exactly simulates syphilitic sarcocele. It may involve one or both testicles. It usually spares the epididymis. It forms an ovoid, hard, indolent, uniform swelling. It is, however, not so hard as syphilitic sarcocele. Its surface is always smooth, and does not present the slight nodulations or ridges which are often present in the syphilitic testicle. Lymphadenoma may be found in other parts of the body.

Enchondromatous growths may present areas of unusual hardness; the growth is often much more rapid and usually attains much larger dimensions than in syphilitic sarcocele. Local and reflex pains are more pronounced, and specific treatment is without avail. However, it is often necessary to wait before diagnosis can be established.

In the acute form of syphilitic sarcocele diagnosis must be made by exclusion; that is, when the possibility of traumatism, of simple inflammation, of gout, of mumps, of tuberculosis, of continued fevers, of violent muscular effort, has been excluded, and other signs of syphilis are present, the syphilitic nature of the affection may be suspected.

Syphilitic fungus of the testicle may be confounded with ulcerating carcinoma or tubercular fungus. The ulcerating carcinoma, however, involves the epididymis and cord, affects the pelvic and post-peritoneal lymphatic glands, forms a large indolent tumor, gives rise to much pain, is attended with bleeding and sloughing, and freely secretes ichorous pus. It runs a rapid course, and is attended with cachexia.

The tubercular fungus differs from the syphilitic only in the fact that the granulations are paler, of less vitality, and not attended with infiltration of the skin. There is usually cachexia.

Prognosis.—The prognosis of syphilis of the testicle is good. There is rarely deterioration of the general health, or abolition of the sexual powers. It cannot be considered as indicating a malignant form of syphilis. Although the disease is bilateral, it very rarely produces complete atrophy or destruction. Even though the testicle seems to be involved as a whole, some portion of the glandular substance is generally spared.

Interstitial orchitis, even if taken in its early period, may be followed by atrophy. Ulcerating gummata rapidly produce most extensive destruction. In spite of the preservation of virile power, spermatogenesis may be arrested. Even after loss of virility and fecundity, proper treatment will sometimes restore both.

Treatment.—There is little tendency towards spontaneous cure. Potassium iodide in full doses should be administered, together with mercury. The latter drug is particularly indicated when testicular manifestations are precocious.

Syphilis of the Vasa Deferentia, Seminal Vesicles, Prostate, Urethra, and Erectile Bodies of the Penis.—There have been reported a few cases of gumma of the vas, usually in connection with syphilitic sarcocele. This structure, together with the seminal vesicles and the prostate, seems to be singularly free from the manifestations of tertiary syphilis; at least clinical evidence of the frequent involvement of these structures is wanting.

Chancre of the urethra has been already described. (See page 110.)

Secondary syphilides, particularly the mucous patch, have been observed on the urethral surface. These occasion a slight discharge, which is sometimes mistaken for gonorrhœa. (See page 109.)

Gummatous ulceration is exceedingly rare, or at least is not often recognized clinically. Its symptoms are usually confounded with those of chronic urethritis from other causes. It would be difficult to make the diagnosis except from urethroscopic examination, unless induration could be detected by external examination. It is followed by dense stricture formation.

The primary and secondary lesions of the penis have been already described. (See page 827 *et seq.*)

The erectile bodies of the penis may exhibit tertiary manifestations in the form of diffuse infiltration or of gummata.

Diffuse infiltration particularly involves the meatus and the frænum, together with the mucous membrane of the prepuce lying to either side of this band. Infiltration may be either superficial or deep, and may involve a considerable portion of the glans. Ulceration sometimes follows.

Gummata are usually placed on the proximal third of the cavernous bodies. They form small or large, ovoid, indolent, non-inflammatory, cartilaginous tumors, suggesting during their early development the presence of a foreign body in the tissues.

Gummata and infiltrations markedly interfere with erection, making it imperfect anterior to the seat of lesion and causing bending of the organ. They are obstinate to treatment, and are scarcely to be disguished from the plates of induration resulting from non-specific cavernitis or fibroid infiltrations.

Diagnosis.—One or more hard, painless, slowly progressive nodules, growing in or from the erectile tissues of the penis, showing no tendency to ulcerate, and giving rise to no symptoms other than interference with erection, would be almost pathognomonic of either syphilis or non-specific indurated plaques. Between these two affections the therapeutic test affords the only means of distinguishing.

The tertiary manifestations, which closely simulate various forms of chancre, are much more chronic in their course than the primary lesion, occasion no adenopathy, and begin as infiltrations, which subsequently ulcerate. Moreover, there is a preceding history of secondary syphilis, or possibly the evidence of pre-existing lesions of the disease.

Treatment.—As for all tertiaries, the administration of potassium iodide and mercury is indicated.

SYPHILIS OF THE OVARIES, UTERUS, VAGINA, AND VULVA.

From analogy it might be expected that syphilitic involvement of the ovary would be frequent. Clinical records, however, have very little to advance in proof of this theory. It is probable that a sclerous and a gummatous type of ovaritis occasionally appear as manifestations of tertiary syphilis. This, however, as in the male.

occasions no subjective symptoms, follows the law of tertiary visceral lesions in not tending to ulcerate, and hence escapes notice. Autopsies have shown that such lesions occur, and a few clinical observations prove, at least so far as the therapeutic test is concerned, that some ovarian tumors are of syphilitic origin. The evidence is strongly in favor of the view that the ovaries are far less subject to tertiary disease than are the testicles.

The Fallopian tubes are involved in gummatous lesions even more rarely than are the vasa deferentia.

The uterus of syphilitic women is frequently attacked by endometritis, metritis, perimetritis, and parametritis. The symptoms and complications are the same as the homologous non-specific inflammations, and often the treatment is as tedious and unsatisfactory. There are some reported cases of uterine tumor disappearing rapidly under the use of potassium iodide.

The vagina is very exceptionally the seat of chancre. Secondary lesions, except the mucous patch, are also rare. Tertiary lesions of the vagina, usually appearing in the form of a diffuse infiltration, commonly extend from the vulva or the rectum, in the latter case causing recto-vaginal fistulæ. Exceptionally the infiltrate attacks the vagina alone. The symptoms are those of chronic vaginitis, with marked thickening particularly of the posterior wall, often followed by ulceration and extensive tissue-destruction.

The vulva is a favorite seat of syphilitic lesions in all stages of the disease. The chancre, secondary syphilides, gummata, and gummatous infiltration are all frequently observed. The tertiary lesions are prone to develop in the seat of primary and secondary ulcerations. They are usually multiple, bilateral, quickly ulcerate and spread, and produce a thickening and warty growth of the skin, which strongly suggests elephantiasis. In the debilitated and uncleanly phagedæna develops, with extensive tissue-destruction, and, in case of healing, great cicatricial deformity.

SYPHILIS OF THE MAMMARY GLAND.

CHANCRE about the nipples is frequently observed, nearly always as a result of suckling a syphilitic child.

SECONDARY LESIONS similar to those found on other surfaces of the body develop on the tegument covering the breast. Papules are particularly liable to be converted into mucous patches or into condylomata.

ACUTE IRRITATIVE MASTITIS is exceptionally observed in both men and women in the earliest period of secondary syphilis. It is characterized by swelling accompanied by moderate pain and tenderness; it subsides quickly, particularly under specific treatment.

GUMMATOUS MASTITIS may be diffuse or nodular.

Diffuse gummatous mastitis is characterized by a rather dense infiltration involving a part or the whole of the breast. Both breasts may be attacked together or consecutively. More commonly one side is involved. If untreated, atrophy and contractions take place, ultimately leaving the breast wasted and greatly deformed.

The diagnosis from cancerous infiltration may be extremely difficult, but will be founded upon the more diffuse form of the syphilitic infiltration, the absence of lymphatic involvement, the preceding history of syphilis, and chiefly on the rapidity with which symptoms yield to constitutional treatment.

Gummatous nodules of the breast develop slowly, occasion little or no pain, and are prone to ulcerate and discharge. There is found in or on the breast a hard, painless, non-sensitive, freely movable nodule, which in a few weeks has reached the size of an egg, softened, become adherent to the skin, ulcerated, and discharged a turbid, gummy fluid.

As in the case of diffuse infiltration, these gummata may lead to errors in diagnosis. Gummata do not retract the nipple, they commonly develop before the age of cancer, and they ulcerate in a different way from typical malignant growths. Usually the lymphatic glands are not involved, and a history or signs of syphilis are obtainable.

Specific treatment ordinarily accomplishes prompt resolution of tertiary manifestations in the breast, and is the main test upon which a differential diagnosis must be founded.

THE PROGNOSIS OF SYPHILIS.

Most of the deaths in syphilitics are from intercurrent tuberculosis. Crippling sequelæ of the primary and secondary disease are in inverse proportion to the efficiency of treatment. When tertiaries recur, intermittent treatment should be continued for many years.

The mortality of syphilis is due to its tertiary lesions. Aneurism, arterio-sclerosis, tabes dorsalis, general paresis, cirrhosis of the liver, and kidney diseases are the common causes of death. Seventy-five per cent. of tabes are due to syphilis. Bramwell has noted that in seventeen of thirty-two cases of fatal tabes in which the exact date of syphilitic infection was known the expectation of life was diminished an average of nearly sixteen years for each patient. Even a greater percentage of cases of general paresis are of specific origin, the average duration of expected life being diminished in each case by twenty years. This disease runs its fatal course in from two to six years.

CHAPTER XXVII.

SYPHILITIC HEREDITY.—HEREDITARY SYPHILIS.

SYPHILIS is transmitted not as a tendency or predisposition, but as an active contagious disease. It may reach the child (1) by descent from the father; (2) by descent from the mother; (3) by descent from both parents (mixed heredity); (4) by direct infection.

Descent from the father, or seminal transmission, is far more frequent than maternal descent. It represents the simplest form of heredity, since the influence of the father, so far as the child is concerned, ceases when impregnation is accomplished. Provided there are no lesions of the genital tract causing a contagious discharge to mingle with the sperm, the latter, if inoculated upon a healthy person, will not cause the development of chancre; it is as free from contagious properties as other normal secretions; yet when fertilizing the ovum it carries with it the syphilitic infection.

In the florid stage of a virulent syphilis the disease is most likely to be transmitted. A child may, however, be born healthy even under such circumstances. On the other hand, a father who has been free from symptoms of syphilis for years may, as a rare exception, beget a child exhibiting a virulent form of the hereditary disease.

Descent from the mother may be due (1) to infection previous to conception, or (2) to infection occurring at this time, or (3) to post-conceptional infection.

Maternal descent is more certain and is more potent in its influences for harm than is that from the father, since the blighting effect of an ovarian infection is reinforced by the devitalizing influences of a maternal dyscrasia.

When the mother is infected at the moment of conception the case becomes in reality an example of paternal heredity, since the germ is syphilitic not because the ovule of the mother is infected, but because of the diseased spermatozoa of the father. During the period of intra-uterine life the syphilis acquired by the mother develops and exercises its malign influence upon blood and the general nutrition, thus further affecting the already diseased fœtus: hence syphilis inherited under such circumstances is particularly liable to be severe. Moreover, there are distinct placental lesions which aggravate the tendency to abortion and still-birth.

In consequence of cell proliferation in the villi the vessels are compressed and finally obliterated, and the vascular spaces into which the villi dip often disappear. The epithelium is also thickened, and thus there is material interference with the interchange between maternal and fœtal blood. If this process is generally diffused over the placenta, the fœtus, of course, perishes. If it is partial, the fœtus may live for a varying length of time, but will exhibit the signs of malnutrition. The earlier the fœtus is infected the more serious the results.

Maternal heredity, most potent in the first year of syphilis, gradually becomes attenuated; but even in the later periods transmission is much more likely to occur than it is from paternal syphilis of the same stage.

Neumann, as the result of a statistical study, shows that two-thirds of the cases of germinal syphilis perish either *in utero* or shortly after birth.

Post-conceptional syphilis—that is, infection of the mother during the period of utero-gestation—may be transmitted to the fœtus up to the eighth month. After that it is probable that the child will escape, although cases are reported showing that chancre acquired in a woman as late as the eighth month has been followed by syphilis of the child.

Syphilis derived from the mother healthy at the time of conception but contracting the disease during the period of gestation, and infecting the fœtus through the placental circulation, is not classed by Fournier as hereditary syphilis, since under these circumstances the healthy ovule impregnated by healthy spermatozoa inaugurates a normal growth not interfered with till it is well advanced. Lesions are, therefore, less severe than they are when the germinal cells are diseased.

Mixed Heredity.—When at the time of conception both parents are suffering from syphilis in its early stages, the disease is almost certain to be transmitted, and usually in a lethal form.

The relative gravity of the three forms of descent is expressed by Fournier's tabulation, based on five hundred observations. Among the cases of paternal heredity twenty-eight per cent. died, and thirty-seven per cent. showed lesions of syphilis. Among the cases of maternal heredity sixty per cent. died, and eighty-four per cent. showed lesions of syphilis. Mixed heredity caused sixty-eight and a half per cent. of deaths, and lesions in ninety-two per cent. These estimates demonstrate that paternal heredity, though more frequent than the other forms, is less than half as communicable or fatal as is maternal heredity, and that the latter is less virulent in its effects than mixed heredity.

Direct infection implies inoculation of the child during parturition by the contagious discharges of secondary vaginal or vulvar lesions of the mother. This cannot be classed as hereditary syphilis. There seems to be no reason why such infection should not exceptionally take place, provided the mother is suffering from active genital lesions acquired too late to affect the child *in utero*. That there is lacking a sufficient number of entirely satisfactory reports of such infection to prove conclusively that it exists would seem to show that the child has acquired a certain immunity somewhat similar to that expressed by Colles's law; in other words, that it either has a latent modified form of the disease, or, from antitoxin absorption from the mother's blood, has ceased to be susceptible to it.

Syphilis thus conveyed would be acquired, not inherited, and would begin with the primary sore.

The Period of Syphilitic Heredity.—It is universally conceded that hereditary syphilis becomes milder in type and less likely to be transmitted in proportion to the age of the disease of the parents. Heredity is most potent and virulent in its first year. There is a rapid attenuation in the third year, after which the influence of the disease as expressed by transmission still diminishes, but at a slower rate. In the large majority of cases there comes a time when syphilis is no longer transmissible. This rule, however, is subject to exceptions, although it is true that tertiary or late symptoms of syphilis are non-contagious, and probably sequelæ of the lesions of the active period of the disease. The question as to transmission years after the original outbreak, and in the absence of all signs or symptoms of the disease in the parents, is important. Such transmission is possible, and is, perhaps, more common than is generally supposed. Fournier states that of five hundred and sixty-two cases of hereditary syphilis, in sixty the disease was transmitted more than six years after the primary infection. Apparently carefully observed cases are recorded pointing to heredity from parents in the fifteenth and even in the twentieth year of syphilis.

Treatment exercises upon the heredity of syphilis a more powerful effect than time alone. Thus, Fournier shows that after the exhibition of the specifics the mortality in maternal heredity is reduced from fifty-nine per cent. to three per cent., and that children born living are usually free from signs of syphilis.

The type of parental syphilis does not necessarily indicate that of the inherited disease. Heredity in its most malignant form may destroy the offspring of parents suffering from mild syphilis, and, conversely, virulent outbreaks in the parents may not interfere with the birth of children either but slightly affected or absolutely healthy: hence it is unsafe to base prediction as to the type of inheritance upon the type of disease of the parents.

Conceptional syphilis is that acquired by the healthy mother from a fœtus infected by the father. In the vast majority of cases maternal syphilis is acquired by the mother from direct absorption of the poison through a breach of surface, the first manifestation of disease then being a chancre, which is followed by a train of secondary and tertiary symptoms. She can, however, also acquire syphilis through the medium of the placental circulation of a child seminally infected by the father. This method of contagion, long questioned, is amply proved. Thus, there are many reported cases showing that even though the father is free from discoverable lesions at the time of conception, and there is no history or trace of a primary lesion in the woman, yet she may exhibit the phenomena of syphilis. Provided both husband and wife are really free, the one from contagious lesions, the other from evidence of the present or previous primary sore, it will often be found that the woman has either been delivered of a syphilitic child or has had an abortion or a miscarriage some time before the outbreak of the symptoms of the disease.

Colles's law, which states that a child begotten by a syphilitic father and born of an apparently healthy mother cannot infect her, even though it exhibit venereal ulcers on the lips and tongue and in suckling cause cracks and fissures in the mother's nipple, was formerly regarded as a positive proof that the mother of a syphilitic child was always herself syphilitic, since only in this way could her immunity be explained.

Diday applies to the explanation of this well-known phenomenon Pasteur's discovery that methodical repetition of inoculation attenuates and ultimately neutralizes the virus of disease. This is shown when animals are repeatedly inoculated with the virus of hydrophobia. When a woman bears a syphilitic child the blood freely circulating between mother and fœtus becomes a vehicle for repeated inoculation of the attenuating fluid, and the mother is rendered proof against syphilis by seven or eight months of perfected Pasteurization.

Conceptional syphilis may appear in one of two forms:

1. The woman may immediately after conception become languid, weak, and emaciated, complaining of headaches, rheumatic pains, sleeplessness, and all the symptoms of neurasthenia. Miscarriage occurs, and from this she rallies very slowly. Subsequent pregnancies take much the same course, the miscarriages coming later in the period of gesta-

tion. Then living but syphilitic children, and finally healthy children, are born.

In many cases undoubted tertiary symptoms appear, such as gumma or periostitis. All these symptoms are usually rapidly cured by specific treatment.

2. The woman may remain apparently well, being delivered at about full term of a child which either at birth or shortly after exhibits the characteristic lesions of hereditary syphilis. Experimental inoculation of such a mother with active virus will not produce chancre. She is immune against syphilis, either because she has the disease in a latent form or because of the protective action of antitoxins.

The question as to why in some cases the mother exhibits the symptoms and lesions of syphilis and in others shows no sign of the disease except the immunity expressed by Colles's law is still unanswered. An ingenious and satisfactory theory, but one still unproved, explains this difference on the ground that the unbroken placenta proves an insuperable obstacle to the migration of the specific germ, but allows the antitoxins to filter freely: hence the mother becomes immunized without contracting the disease. When through injury or other cause lesions of the placenta allow the maternal and the fœtal blood directly to intermingle, the mother receives into her circulation not only the antitoxins but also the active living germs: hence she develops the disease, possibly in an attenuated form because of the continued antitoxin absorption. The same reasoning applies in the explanation of the immunity of the apparently healthy children of syphilitic parents from contracting the disease. (Profeta's law.) In the great majority of cases this is because they already have syphilis in an active or a latent form. In the case of seemingly healthy children of tainted heredity there may have been antitoxin absorption from the mother without infection by the germ.

Syphilis and Marriage.—The prevalence of acquired syphilis, the frequency with which it is transmitted, the severity of its lesions, and its crippling, deforming, and often fatal effects when it is inherited, make questions pertaining to the marriage of syphilitics of cardinal importance. Opinions upon this subject should be clear and decided.

From what already has been said it is obvious:

1. That syphilis is most apt to be inherited from parents who at the time of conception are in their first year of the disease. The aptitude is greatest when both parents are syphilitic, is slightly less when the mother alone is affected, and is diminished more than half when the father alone is affected.

2. That the tendency towards heredity becomes rapidly less from the first to the third year, and after the fourth year is rarely manifested.

3. That time in conjunction with vigorous continued specific treatment so affects the tendency to heredity that after the fourth year it is practically brought to the vanishing-point.

4. That time and vigorous treatment combined cannot always prevent the transmission of syphilis by heredity. The instances in which such transmission has occurred after four years, in spite of active treatment, are, however, so few that they properly can be rejected in considering syphilis and marriage.

The logical deduction from the foregoing summary is that men who have syphilis which has been treated carefully for four years can marry and will have healthy children. When the woman is syphilitic, or both the man and the woman have contracted syphilis, it would be safer to avoid conception till after a longer period.

Prognosis of Syphilitic Heredity.—When conception takes place during the early secondary period of syphilis the usual result is abortion, occurring from the first to the fifth or sixth month, the fœtus sometimes exhibiting the evidences of syphilis in the shape of large bullæ upon the palms and soles, or other characteristic lesions, but quite often showing nothing distinctive. Later, when the virulence of the disease of the parents is lessened by time, either abortion occurs when pregnancy is more advanced, or live children are brought into the world which at birth or afterwards show signs of syphilis. One-fourth of these die within the first six months. If they survive that period the chances for life are slightly in their favor, but the chances for health or freedom from disease are overwhelmingly against them. Fournier states that, in general, the chances of transmission are fifty in the hundred, and that the infant mortality is forty-two per cent.; in hospital practice this mortality percentage is doubled.

When the question of prognosis is considered in regard to individual cases, it is safe to predict healthy children from parents who at the time of conception are past the fourth year of syphilis and have been persistently treated. Even after two years in the very great majority of cases the same outlook is justifiable. In the first year prognosis in this respect must be more guarded; but, provided the mother is actively treated during the whole period of utero-gestation, the child will probably be born healthy. Exceptionally families show an inveterate tendency to heredity little influenced by time and treatment. Fournier quotes a case of nineteen pregnancies each resulting in still-birth. In speaking of the prophylaxis of hereditary syphilis, he earnestly advises that a man who has been infected with the disease should be forbidden marriage till time and treatment have accomplished their depurative work, and should be shown without mitigation and without exaggeration the evils which may result from sexual intercourse. He should be told that he may infect his wife directly by sexual contact, or indirectly through the medium of the fœtus, and that, if she fails to abort, she may deliver at term a wizened, deformed, blotchy child, which if it lives may show the stunted development and mental incapacity so characteristic of hereditary syphilis.

When, in spite of warnings, it is probable that sexual life is continued, the man should be subjected to the most rapid and efficient treatment applicable. When conception has taken place from a syphilitic father, whether the mother has or has not the disease, she should receive active specific treatment during the whole period of utero-gestation.

HEREDITARY SYPHILIS.

Hereditary syphilis differs from the acquired disease in being constitutional from the first. There is no primary stage,—that is, there is no chancre,—nor in the course of its development can the manifestations of the disease be classed under periods. They may correspond in type to secondary or tertiary lesions, but a chronological order such as is observed in acquired syphilis is wanting. For the first two years after birth secondary and tertiary manifestations appear side by side. Later, at about the time of puberty, for instance, if lesions appear, they belong exclusively to the tertiary type.

The local expressions of hereditary syphilis correspond closely with those already described as characteristic of the acquired disease. Thus, the syphilides are pathologically and clinically the same, and this is true of visceral involvements. The main point of difference lies in the profound alteration which syphilis in its hereditary form impresses on general nutrition and development.

In a certain proportion of cases the characteristic symptoms of hereditary syphilis develop at birth or within a few days of this time. Often the child remains apparently healthy for a period of from three to five weeks, manifestations of syphilis then appearing. It seems well substantiated that a child may be born healthy and may show no symptoms of syphilis for several years, after which time typical tertiary lesions may develop. In many of these cases it is probable that the post-natal lesions were so few and slight that they were not observed. The form of the disease developing more than three years after birth Fournier called late hereditary syphilis.

The typically syphilitic child is at birth a wasted, wizened, snuffling, feeble creature, with a weak, hoarse cry, often exhibiting a bullous eruption of the skin. It has been blasted *ab initio*, presenting the appearance of an advanced stage of marasmus. The skin is harsh, non-elastic, and gray or dirty yellow in color; its appendages—the eyelashes, eyebrows, hair, and nails—also show imperfect or perverted development. The muscles are wasted. The general condition is well expressed by the term *atrophia neonatorum*, which, though it may result from a number of prenatal causes, reaches its most striking development in hereditary syphilis. Such children rarely survive.

When the influence of heredity is manifested in a less virulent form the child may be born properly developed and apparently well nourished. In a few weeks lesions of the skin, mucous membranes, and eyes develop, corresponding in type to the expressions of acquired secondary syphilis; these are frequently associated with infiltrations of the viscera and bones, which pathologically belong to tertiary syphilis.

Following the first outbreak there is an intermediary period, lasting a year or eighteen months, till second dentition, till puberty, or even through life. It is mainly characterized by absence of symptoms. The general expression of the syphilitic diathesis is present, marked possibly by malnutrition, retarded development, wizened face, and sunken nose, but there seems to be little tendency towards renewed outbreaks of secondary lesions.

The tertiary stage, corresponding to the tertiary period of the acquired disease, manifests itself at the period of second dentition, about the time of puberty, or towards the end of middle life. Its lesions may, of course, develop at any time, and it may remain latent to the age of sixty (Fournier).

SKIN AND MUCOUS MEMBRANE LESIONS OF HEREDITARY SYPHILIS.

These correspond in general with those of acquired syphilis, but are more severe, and at times appear in the form of diffuse infiltrations. They vary somewhat in accordance with their time of appearance after birth. Those which are found at birth are most pronounced. Thus, it is not infrequent to observe a pemphigus so extensive that a greater part of the epidermis is involved and is shed in large strips. The mucous membrane is similarly affected at the same time. The lesion at birth may be pustular or ulcerative in type. In either case the arrest of development, hoarse voice, snuffles, and other signs of the disease are usually characteristic.

When the child is born apparently healthy, the symptoms not developing for some weeks, the skin eruption is commonly erythematous and papular in type, at least primarily, and coincidently with its appearance snuffles, sore mouth, hoarse voice, and general emaciation are noted.

Erythematous (roseolar) syphilides differ from those of the adult only in the fact that the epithelial layer of the skin is more readily macerated, particularly where the integument is creased or folded, as about the neck, the genitalia, or the buttocks, and there results an abraded surface, presenting the appearance of a mucous patch.

Syphilitic roseola is apt to develop about the second or third week after birth, and first appears on the body in the form of small, oval, rounded, or irregular spots, dull red in color, and disappearing upon pressure.

Sometimes the eruption is confluent, covering large areas, with an almost unbroken sheet of dull red color.

It is frequently placed about the genitalia and on the face, thus differing from acquired syphilitic roseola.

The diagnosis of syphilitic roseola is sometimes difficult, as it may closely resemble simple erythema. The progress of the disease to the formation of papules, becoming scaly on the palms and soles, and the prompt yielding to mercurial treatment are characteristic features of syphilis.

Papular Syphilides and Mucous Patches.—These lesions are most marked upon the buttocks, palms, soles, and face, but may be diffused over the entire body. The small papules are situated in groups, sometimes rounded, more often irregular in shape, and tend to coalesce and form broad, flat papules. In the corners of the mouth they are converted into painful, bleeding fissures, which on healing leave permanent scars. These scars serve a useful diagnostic purpose in later life. Exfoliation is most marked in the plantar and palmar papular syphilides, which when confluent may cause the epidermis to be shed in large strips, exposing a thick, raw-ham-colored infiltration of the true skin. This corresponds in type to the plantar and palmar psoriasis of acquired syphilis, and may be complicated by painful cracks or fissures.

Papules when exposed to heat and moisture, as in the folds of the buttocks, lose their surface epithelium by maceration, become excoriated, and cause an offensive discharge. These mucous patches are formed most commonly about the anus or the angles of the mouth. Neumann states that they never exhibit the papillary overgrowth so common in the acquired disease.

The papular form of hereditary syphilide is much more obstinate to treatment than is the roseolar form of the disease.

Vesicular syphilide appearing in the form of small discrete blebs is usually associated with the papular and papulo-pustular lesions. When the individual vesicles are large, their contents soon become purulent. The small vesicles are grouped, and are placed on indurated papules. The eruption is rare, and is often a sign of severe infection.

Pustular Syphilide.—The lesions of this syphiloderm commonly succeed the papular eruption, though they may be noted at birth or may develop as the first symptoms. Frequently they do not appear until several years after the first outbreak.

The pustules vary in number, size, and depth in accordance with the severity of the disease. They are most frequently seen on the buttocks, thighs, scalp, face, hands, and soles, and are said to indicate the probability of late tertiary outbreaks.

As in the adult, the pustular eruption may take the form of acne, impetigo, or ecthyma. Syphilitic impetigo is most frequent on the face and scalp. The axillary and inguinal regions are also seats of preference. Distinct, often deep, ulceration beneath the crusts, and copper-colored infiltration of the periphery of the lesion, differentiate the syphilitic affection from simple impetigo. Syphilitic ecthyma attacks the buttocks and thighs by preference, forming large, flat, infiltrated pustules, the thick crusts of which conceal deep ulcers.

Nearly all these pustular lesions leave permanent scars; they may be complicated by cellulitis and gangrene, leading to wide-spread destruction of the skin.

Bullous Syphilide.—The bullous syphiloderm or pemphigus commonly appears on the soles, palms, fingers, toes, or limbs. The eruption consists of blebs more or less irregularly distended with liquid, which may be clear, cloudy, or bloody. It begins as dark, circumscribed infiltrates, from which the epidermis is shortly raised in the form of blebs.

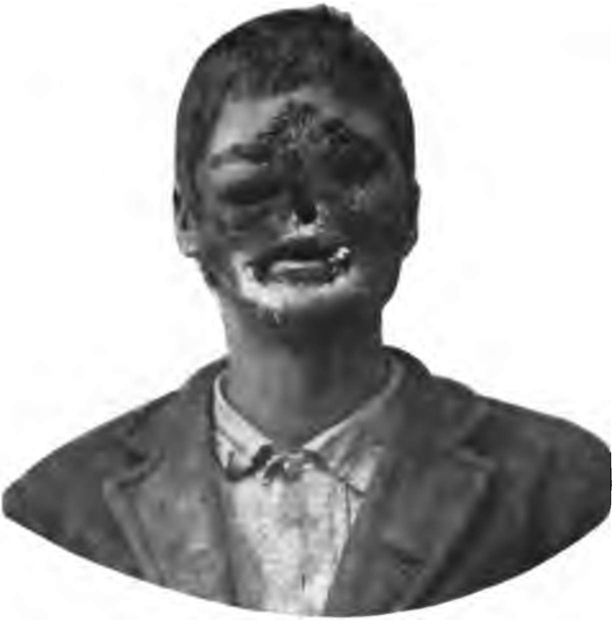
These blebs are circular or oval in shape, sometimes irregular, are seated on inflamed reddish skin, are surrounded by a slight areola, and have a tendency to become confluent and spread. When a child exhibits such an eruption at birth or immediately after, the presence of syphilis should be strongly suspected, and will be quite certain if, in conjunction with the pemphigus, the general cutaneous surface is yellow or muddy in hue, is without elasticity or softness, owing to the absence of subcutaneous fat, and is for the same reason so furrowed and wrinkled about the face that the child presents an appearance of senility, and if there are also other syphilitic skin-lesions and the child has snuffles and a hoarse cry.

The appearance of pemphigus is ominous, denoting an extreme degree of poisoning by the syphilitic virus.

When the bullæ of pemphigus are filled with serum deeply stained with blood, there may be an associated hemorrhagic syphilis,—that is, a form of the disease characterized by a purpuric eruption, by bleeding from the mucous membrane of the nose, mouth, and gastro-intestinal tract, and by visceral hemorrhages. The bleeding is due to syphilitic degeneration of the blood-vessels, especially the veins and capillaries. These hemorrhages, usually multiple and slight, are most likely to occur just after birth, at the time the cord is tied. Such cases are almost invariably fatal.

Tubercular and Gummatous Syphilides.—Tubercular and gummatous lesions may appear at any age, but are most common from the tenth to the twenty-ninth year. They may assume the dry or the ulcerative form, and usually exhibit a circular or circinate grouping. There is commonly but a single group. The seats of predilection are the face, particularly the nose, and the anterior surface of the leg. They appear in the form of painless, slowly increasing, raw-ham-colored infiltrations, which commonly ulcerate and are covered with thick crusts. These ulcers may heal, or may slowly extend,

Fig. 312.



Tubercular and gummatous ulceration of hereditary syphilis.

forming phagedenic or serpiginous lesions. Non-ulcerating infiltrations absorb, leaving atrophic areas; the ulcerating lesions leave deforming cicatrices: hence the importance of early recognition and prompt treatment of these syphilides. They closely resemble lupus, particularly when the face is attacked. (Fig. 312.)

Diagnosis.—The differential diagnosis between dry tubercular syphilide and non-ulcerating lupus is founded upon the dusky-red color of the syphilide and the firm induration. Tubercular nodules exhibit a more translucent, yellowish red, and are more yielding to pressure. (Fournier.)

The differential diagnosis between the ulcerating syphilides and lupus (Fournier) is founded upon:

1. *Areola.*—The areola of the syphilide is dusky red, that of the scrofulide is lighter, sometimes of a bluish tint.

2. *Crusts.*—Those of the syphilides are more homogeneous, more compact, thicker, and harder than those of the scrofulides. They are more frequently stratified and more deeply colored, almost black or greenish black.

3. *The Borders of the Lesion.*—In syphilides these are always sharply marked, elevated, infiltrated, punched out, and adherent. In lupus they are less distinctly outlined, are flat, soft, often reduced to a simple ulcerating circumference. They are not punched out, and are often loose and undermined.

4. *The Base of the Ulcer.*—In tertiary syphilis this is deep, irregular, anfractuous, and exhibits a yellowish, adherent, semi-solid covering, representing the necrosed gummatous infiltrate. Lupus shows ulceration more on a level with the surrounding surface, with cherry-red granulations, sometimes exuberant, sometimes presenting a smooth glistening surface.

5. *Configuration of the Lesion.*—Often, but not invariably, the syphilitic lesions form a complete circle, a portion of a circle, or serpentine undulations. The ulcers of lupus are more irregular.

It is not, however, on these minor points of difference that the diagnosis will in the main be founded, but rather upon the method of evolution, the presence or absence of other more characteristic lesions, the previous history, careful physical examination of the patient, and the family history.

The gummatous syphilide when it appears as a diffuse eruption commonly undergoes rapid degeneration, presenting much the appearance of furunculosis.

Onychia of a dry and ulcerating form, and *alopecia*, are observed in connection with the skin-lesions of hereditary syphilis.

The lesions of the mucous membrane correspond in type with those observed upon the skin; thus, when pemphigus is noted, large or small raw surfaces will be found upon the mucous lining of the throat and tongue; when papular and papulo-pustular eruptions develop on the body, typical mucous patches will be found in the mouth,—that is, superficially ulcerated infiltrations covered with a grayish necrotic membrane.

Not only the mucous membrane of the mouth and pharnyx but also that of the nose, ear, and larynx is liable to inflammation. Indeed, syphilitic coryza is one of the most characteristic and at the same time one of the most important of the early symptoms of syphilis, since by its interference with respiration it materially hinders the proper nutrition and development of the child. This condition of the nasal mucous membrane is shown by a thin, watery, irritating discharge, which dries in crusts about the nasal orifice; beneath these crusts are found excoriations and ulcers. The catarrhal swelling of the mucous membrane and the crusting produce so much narrowing of the air-way that respiration is difficult and noisy, the latter symptom giving the popular name "snuffles" to the affection. Mucous patches, erosions, and ulcers form on the lips, particularly at the angles of the mouth, and on the tongue, the gums, the palate, and the pharynx. Caries and necrosis of the palate and of the nasal bones frequently complicate these ulcerations (syphilitic ozæna).

The larynx is commonly affected, showing the infiltrations, erosions, and ulcerations noted on other mucous surfaces, and causing the characteristic hoarse voice. Exceptionally infiltration narrows the air-passage to the point of producing marked dyspnœa, or even death.

Later in the course of the disease—*i.e.*, after some years or about the time of puberty—typical tertiary manifestations may appear. These are similar to those observed in the adult. They are characterized by deep infiltrations, which exhibit a tendency to break down, forming ulcers, which are accompanied by few subjective symptoms. Their seat of predilection is the soft palate, but they are often found on the posterior pharyngeal wall, the anterior half-arches, and the hard palate. The mucous membrane of the nose is also affected, and the ulceration is extremely likely to extend to the underlying bone, producing great deformity or even complete destruction of the facial portion of this organ. The hard palate and the nasal septum are usually perforated.

Lupus rarely attacks either the mucous membrane or the bones of the nasal passages, being rather sharply confined to the regions of the anterior nares. In these respects it differs markedly from syphilis.

When tertiary infiltrations attack the larynx, destruction of cartilages may ensue, with deforming and crippling contractures, or the bronchi may be invaded, an obstinate form of bronchitis resulting. Spasm or œdema of the glottis may cause sudden death.

HEREDITARY SYPHILIS AFFECTING THE EYE.

Marginal blepharitis is sometimes encountered as a result of hereditary syphilis, appearing in the form of small irregular ulcers, usually near the corners. The treatment is cleansing and constitutional, together with the usual applications, particularly the ointment of calomel.

The lachrymal apparatus is sometimes involved from extension of inflammation dependent on caries of the neighboring bones.

INTERSTITIAL KERATITIS is the most characteristic eye-lesion of hereditary syphilis. This commonly begins as a slight diffuse haziness, situated in the cornea itself, not far from the centre, and at first affecting but one eye; usually the other eye is affected, but often not for weeks or months. The cloudy deposits lie in the cornea, and not on its surface, and first appear as diffuse spots; these later become confluent until the whole cornea is opaque, a bare perception of light remaining. There are usually photophobia and slight ciliary injection. The disease lasts for a varying period of time, weeks or months; then the cornea first involved begins to clear; the other cornea follows a similar course in time. In most instances there remains a slight permanent haziness, though vision is good. In severe cases the whole cornea becomes congested, blood-vessels developing in its substance. Cyclitis and retinitis are often associated with the corneal lesions, and in bad cases there may be secondary glaucoma and even shrinkage of the eyeball.

Interstitial keratitis is rarely noticed in early infancy, but appears usually between the eighth and the fifteenth year, and in children presenting the typical physiognomy of hereditary syphilis.

Diagnosis.—This is in general easy to make. The ground-glass appearance in the early stages, and the dull pink or salmon color if the vascular stage is reached, are characteristic. In syphilitic keratitis the vessels are deep and closely interwoven, producing almost the effect of an ecchymosis. Moreover, in syphilis the disease is symmetrical, there is a tendency to spontaneous cure, ulceration hardly ever occurs, and there is but slight ciliary congestion. The grooves left by the new-formed corneal vessels are permanent, and their discovery by a magnifying glass long after other traces of keratitis have disappeared will often throw light on an obscure case.

The chief diagnostic point, however, is the association of this form of keratitis with other lesions of syphilis.

Iritis appears before the end of the first six months. It is later than the syphilodermata and of rarer occurrence, but it is extremely important, since, if overlooked, it may result in permanent impairment of the vision. When recognized it constitutes an almost pathognomonic sign of syphilis.

The *diagnosis* is readily made when attention is called to the eye, but the affection may be overlooked, since there are few subjective symptoms.

When the disease is fairly developed the pupil is irregular, especially under atropine; the iris is streaked with lymph, dull, swollen, and discolored. On very careful inspection a faint pink zone of congestion may be seen in the sclerotic, though this is often wanting.

The *prognosis* is generally good; even when the pupil has been occluded, vigorous treatment will cause absorption of the plastic exudate.

The *treatment* consists in the administration of mercury; it is often useful to give it in combination with tonics. When the disease occurs during intra-uterine life, the infiltration is liable to extend to the lens, rendering it opaque; the same result often follows when the disease develops after birth and is not recognized. In this form of lens opacity the operation for cataract promises little good.

Optic neuritis, retinitis, and choroiditis are occasionally observed in the course of hereditary syphilis.

HEREDITARY SYPHILIS AFFECTING THE EAR.

Extension of inflammation from the throat and blocking of the Eustachian tube may cause chronic middle-ear disease, with consequent deafness.

The characteristic syphilitic otitis media is that which develops painlessly, usually within a few weeks or a few months of birth, and gives rise to no symptoms except a purulent discharge, thus differing markedly from the ordinary suppurative otitis media, which is not uncommon in infancy and childhood. This syphilitic otitis yields promptly and completely to specific treatment. If neglected it becomes chronic, producing irremediable changes, which result in partial deafness, suppuration of the mastoid cells, and bone-involvement.

Deafness is characterized by Hutchinson as one of the cardinal symptoms of hereditary syphilis. It is due to labyrinthine changes, usually affecting both ears. These changes in the case of an infant are unaccompanied by subjective symptoms, but result in deaf-mutism.

When the labyrinth is attacked later, at about the time of puberty, for instance, there may be as a premonitory sign painless tinnitus. Deafness develops rapidly, is complete, and is apparently causeless. Treatment is often unavailing.

HEREDITARY SYPHILIS AFFECTING THE TEETH.

The first teeth exhibit malformations and imperfections which are by no means characteristic of syphilis, but which may be referred to any inflammation of the gums sufficiently severe to interfere with the nutrition of the tooth-sacs. Thus, the teeth are often deficient in enamel, or this coating is unevenly distributed, or is opaque and chalky, or the dentine is soft and friable, or the teeth are incongruous in size individually and relatively, and decay readily.

The permanent teeth may exhibit the same perversions of growth and nutrition as a result of stomatitis, whether this inflammation be produced by mercury, by gastro-intestinal derangements, or by local irritation. Mercurial teeth, for example, are irregularly outlined, horizontally seamed, honey-combed, scraggy, malformed, of an unhealthy, dirty yellow color, separated too widely, and deficient in enamel.

Fournier has written as follows concerning the influence of hereditary syphilis on the dental organs: The transmitted taint shows itself on the dental system in two series of manifestations, of very unequal diagnostic value: first, by retardation of evolution; second, by arrest of growth and modifications of structure.

RETARDATION OF EVOLUTION.—This generally applies to the entire first denture. In some cases it is limited to one group of teeth,—the incisors, for example. A similar retardation sometimes is noted in the eruption of the permanent teeth. This is but a localized expression of the general lack of development characteristic of hereditary syphilis.

ARREST OF GROWTH AND MODIFICATIONS OF STRUCTURE.—Perversions of growth may be classified under dental erosions, microdontism, dental amorphism, and vulnerability. Some rarer peculiarities, such as irregularity of alignment and anomalies of reciprocal arrangement, are not included under any of the above headings.

The term syphilitic tooth implies a congenital dental malformation, a deficiency of development stamped by syphilis on the tooth yet unformed during the period of its intrafollicular evolution. The first dentition is not so often influenced as the second. The dental malformations are commonly multiple and symmetrical,—that is, several teeth are affected, and usually corresponding teeth show similar lesions.

Dental Erosion.—This malformation may implicate any portion of the surface or borders of the tooth. Its common manifestation on the front of the tooth is a cupping, comparable to the slight depression which would be left by the point or the head of a pin in soft wax. These cuppings show a dark tint, grayish, brownish, or almost black, and in the deeper depressions enamel is entirely wanting. Erosions in this form are most common on the incisors, and notably on the superior centrals, and are often arranged in one or more horizontal rows.

Faceted erosion is not so common. It usually involves the central incisors, and shows as an irregularity such as would be produced by a file. It is extremely superficial, and can often be detected only by examining the previously dried tooth under a magnifying glass.

The furrowed erosion is the commonest form, and appears as a transverse groove, which may make the entire circuit of the tooth, or may be broken. The groove may be so shallow as to form a scarcely perceptible streak, or it may be deep, as though filed, producing an unsightly deformity, since it soon acquires a dark tint. These furrows are always horizontal and usually single. Sometimes two or three are noticed on the same tooth, occupying the portion of the crown nearest the free edge. In such teeth the free extremity is generally worn thin, partly or totally deprived of enamel, rough, uneven, irregular, brownish, and rapidly wears away. These grooved erosions are most frequent on the incisors.

Surface erosion is rare. It represents simply an exaggerated form of the grooved erosion, covering a large surface of the crown and presenting a wide, unequal, and rough zone filled with alternate points and sinuosities and of a dirty yellow or blackish color. In its most pronounced form it appears as a completely disorganized mass, unrecognizable as a tooth.

The malformations affecting the cutting or grinding surfaces of the teeth present themselves under different forms, according to the class of teeth they affect.

The first molar is the only one among the grinders upon which the influence of hereditary syphilis shows itself. The body of the tooth for two-thirds or three-fourths of its height is normal; its upper surface is atrophied, suggesting a stump of dentine emerging from a normal crown. The masticating surface is rough and of a dirty-yellow or brown tint, and wears away, producing a flat surface with a yellowish centre and a peripheral border of white enamel. This short, flat tooth has a diagnostic significance of high value.

Upon the cuspids erosion of the free edge may appear as a simple notch, similar to a cut made in a piece of wood by two convergent strokes of a knife, or as a true atrophy, producing the appearance of a slender conical stump grafted in a cylinder.

Erosions of the cutting edge of the incisors are more numerous. There may be an angular notch, serration, atrophic thinning, with antero-posterior flattening, or general atrophy, the tooth presenting a normal base, from which emerges a small, rough, dirty-gray stump with an uneven surface.

Finally, there is the crescent-shaped erosion characterized by a semilunar notch, constituting the Hutchinson tooth. The important peculiarity of this last erosion is the semicircular cut in the free edge of the tooth. The superior central incisors are the teeth which exhibit this characteristic crescentic notch. It is impossible to mistake it or seriously to consider it in connection with any other affection of the dental organs. The crescentic notch is the essential characteristic of the Hutchinson tooth, but is not the exclusive one. The notch is nearly always bevelled at the expense of the anterior edge of the tooth; in other words, the anterior border of the crescentic arch is cut obliquely from above downward and from before backward. The typical Hutchinson's tooth is also marked by its rounded angles, the lateral and inferior borders merging by a curved line; it is much reduced in length; sometimes it is narrowed. Finally, the upper central incisors having the Hutchinson notch often deviate from normality in direction, and their axes in place of being parallel are obliquely convergent.

A perfect type of this tooth is best observed in youth. It does not protrude from the gum with a clearly cut notch, appearing first with this notch either partially or completely filled by small or apparently atrophied vegetations of the dental tissue. Deprived of enamel, these vegetations are rapidly destroyed, leaving in their place the smooth crescentic notch, the depth of which progressively diminishes with use. At twenty-five years the vault becomes nearly flat, but even then there remains the bevel of its anterior edge. Later with the wearing of the tooth the bevel disappears, so that beyond the age of thirty years Hutchinson's teeth are not to be found. This dental malformation commonly affects the two teeth symmetrically, often exclusively. Sometimes it is observed in the upper lateral incisors, the inferior incisors, or even the cuspids.

In the second dentition dental erosions are met with in the following order of frequency: first, on the first molars, particularly those of the lower jaw; second, on the incisors; third, on the cuspids. The bicuspids and second and third molars are almost invariably exempt from these erosions.

Erosions are usually multiple and nearly always symmetrical. Those of corresponding teeth maintain the same level on the crown.

As to the semeiological value of dental erosions, the punctate and cup-like lesions of the crown and the saw-like erosions of the free edge have but little value as evidence of specific heredity. Furrowed erosions are more characteristic, but are also caused by other conditions than hereditary syphilis.

Atrophy of the dental cusp, notably that affecting the first molar, and constituting the short, flat tooth, has a more precise meaning, because this is a favorite form of the malformation when caused by syphilis.

The best form—one which can be given as an almost certain evidence of syphilitic heredity—is the semilunar notch of the free border of the central superior incisors. This special form of erosion is a diagnostic feature of incontestable value.

Microdontism, the term implying an unusual smallness of the teeth, sometimes amounting to actual dwarfing, never involves the entire denture. The superior and inferior lateral incisors are the teeth most frequently affected.

Amorphism indicates that a tooth has assumed some shape other than its physiological one. This growth-perversion is almost as frequent as erosion. The teeth may present simply deviation of normal type, exhibiting characteristics of a class to which they do not belong, or they may be so malformed that they become true monstrosities, forming shapeless masses.

Typical erosion, microdontism, and the lesions of amorphism may be associated. The tooth affected by syphilis is always vulnerable and subject to secondary deteriorations. Caries develops at an early age. The first molars are the teeth most exposed to these degenerations. They are often destroyed in youth.

Among the least common lesions of syphilis, Fournier describes a white linear stripe running horizontally over the crown of the tooth from one lateral border to the other, usually placed on the superior central incisors, and affecting both alike. Irregularities of implantation are also frequent, the teeth being often separated from one another by large empty spaces.

It may be considered as well established, then, that when the two upper central incisors are stunted, abnormally narrow at the cutting edge, crescentically rounded with the convexity upward, and the surface inclined upward and forward instead of backward, as in normal teeth, widely separated, but converging at their lower edges, they are pathognomonic of hereditary syphilis. Other lesions of the enamel or dental substance, possibly with the exception of the incomplete development of the first molar described by Fournier, although frequently caused by hereditary syphilis, may be due to other dyscrasiæ, and in themselves are not characteristic.

HEREDITARY SYPHILIS AFFECTING THE BONES AND JOINTS.

The bones are much more frequently involved in hereditary syphilis than in the acquired disease. They are usually attacked between the fifth and the nineteenth year of age (Fournier), though they may be involved at any stage of the disease. As hereditary syphilis develops in young children it attacks by preference the bones of the cranium and nose and the long bones, particularly the tibia. Later in life the skull is affected in a smaller percentage of cases, the tibia still exhibiting lesions most frequently.

As in acquired syphilis, the essential lesions are those of periostitis, ostitis, osteomyelitis, and gummatous infiltration. They are usually formative rather than destructive in type.

Osteochondritis occurring at the diaphyso-epiphyseal junction of the long bones is pathognomonic of syphilis. It is characterized by a marked widening of the cartilaginous plate between the epiphyses and the diaphyses, by irregular growth of the bone layer just beneath the cartilaginous plate, and by softening at this point of juncture, allowing epiphyseal separation. Microscopically there is found a proliferation of cartilage cells and an arrest in the transformation of these cells to bone.

The symptoms of this form of osteochondritis are as follows:

The bones most frequently attacked are the humerus, radius, ulna, tibia, and femur, but the ribs, sternum, and bones of the metatarsus and metacarpus are also often involved. The more pronounced the syphilis of the parents or the nearer the date of conception to the time at which their infection occurred, the more probable is it that several bones will be affected and the more unfavorable is the prognosis as respects the life of the child.

There is a swelling at the diaphyso-epiphyseal junction of one of the long bones, appearing in the form of a smooth ring or collar, which more or less completely surrounds the bone. In the course of some weeks, as the swelling becomes more pronounced, there may be a moderate amount of synovitis present, particularly when the disease is placed about the knee or the elbow-joint. At this stage—*i.e.*, that of overgrowth and infiltration—the lesion is readily influenced by specific treatment and well-regulated pressure.

If softening and suppuration take place there is complete separation of the epiphyses and diaphyses, shown by preternatural mobility, crepitus, and syphilitic pseudo-paralysis, the affected limbs losing all power. The pus may break into the joint-cavity, destroying the cartilage, or may burrow into surrounding soft parts. The lesions of osteochondritis are usually multiple.

The bones of the skull, particularly the parietal, frontal, and occipital, are affected by formative lesions.

Microcephalus, possibly due to premature ossification of sutures or lack of development of the cerebrum, hydrocephalus, or lack of symmetry in the shape of the cranium, may be noted.

Lack of symmetry is especially frequent and characteristic. Fournier has described a number of types: thus, there are the broad, high, bulging forehead; the bossed forehead, the projections on either side corresponding to the frontal eminences, with an apparent depression in the middle; and the keeled or chicken-breasted forehead, with a median projection. The asymmetry in these cases is due to formative osteoperiostitis of the frontal bones. When the parietal bones are affected there results the natiform skull, presenting apparent broadening of the cranium, with a central depression, suggesting the shape of the nates. When the nodes or exostoses are found in the regions of the frontal and parietal eminences they are often called "Parrot's nodes."

The degenerative lesions of the skull are characterized by tumor-formation, softening, breaking down, and extensive ulceration and destruction of bone-tissue. After the first few years of life the cranium is rarely affected; the bones of the nose, however, are not spared.

The bones of the nose and face are rarely affected in early infancy; when they are involved later in life, it is usually from an extension of disease, which primarily attacks overlying soft parts.

With regard to the long bones, the tibia is the telltale above all others. Swellings and nodes are the rule, deforming the diaphysis, either flattening out the crest or by bony deposits curving it until it has the shape of a sabre. This sabre-shaped tibia is a most important evidence of hereditary syphilis. The chicken-breasted thorax is also frequently observed.

Exceptionally syphilis manifests itself in the form of a rarefying ostitis, predisposing to fracture.

Diagnosis.—The bone-lesions of hereditary exostoses can be recognized by the fact that they are stationary, appear later than those of syphilis and are of larger size, are accompanied by no syphilitic history or symptoms, and resist specific treatment. Syphilitic osteochondritis, followed by separation of the epiphyses and complicated by suppuration and sinuses, may be mistaken for a similar condition due to non-specific inflammations; the latter, however, occur much later in life, are attended with more acute inflammatory symptoms, and are not accompanied by other symptoms or traces of syphilis.

The characteristics of the specific and of the non-specific osteoperiostitis may be thus contrasted:

Syphilitic Osteoperiostitis.	*Non-Specific Osteoperiostitis.*
Occurs in infants under three months of age.	Seldom, if ever, occurs in children under one year of age.
History of syphilis in child and its parents.	No history of syphilis; sometimes a history of traumatism.
Implication of other bones.	Usually confined to one bone.
Coincident with the development of the shaft of the bone.	Coexists with the ossification of the epiphyses.
Other lesions of syphilis,—nodes, skin-eruptions, etc.	No such symptoms.
All the local symptoms comparatively mild.	Pain, redness, and swelling very marked.
Disease sharply localized.	Involves neighboring parts.
Lymphatics of limb unaffected.	Lymphangitis sometimes present.
Beneficial effect of specific treatment if employed early.	No such effect.

Rickets so frequently complicates syphilis that the latter is often regarded as the essential etiological factor in the development of this disease of the bones. This, however, will not stand the test of clinical investigation. As is the case with tuberculosis, which often runs its course in conjunction with hereditary syphilis, rickets is a distinct disease. The contrasted characteristics of the two affections may be thus tabulated:

Osseous Lesions due to Inherited Syphilis.	*Rickets.*
The swellings, particularly those of the long bones, show themselves at or soon after birth.	Rarely appear before six months, generally still later.
A history of syphilis or evidence of existing syphilis in one or both parents.	No such history necessarily.
Preceded or accompanied by snuffles, coryza, and cutaneous and mucous lesions.	No such prodromata.

Osseous Lesions due to Inherited Syphilis.	*Rickets.*
Prodromata recognized as characteristic of rickets do not precede the bone-disease.	Pallor, restlessness, sweating, nausea, diarrhœa, etc., constitute a combination of symptoms which often precede the bone-disease.
Cachexia absent or moderate.	Cachexia marked.
Physiognomical peculiarities of syphilis present.	Not present as a group.
Circumscribed tumors on parietal or frontal bones, rarely on occiput.	Cranial bones thickened in spots, usually upon the occiput.
Ribs not markedly affected.	All or nearly all involved.
Disease of ribs, when existent, not ordinarily coincident with that of other bones.	Nearly always so.
Fontanelles close at usual period.	Closure delayed.
Other syphilitic symptoms present,—enlargement of phalanges, metatarsal bones, etc.	Syphilitic symptoms absent.
Often accompanied by sinuses, synovitis, abscesses, cutaneous ulcers, etc.	Little external or surrounding involvement.
Generally disappear by resolution, without leaving any permanent change.	Usually leaves some bending of shaft and distortion of the neighboring joint.
Mortality among children in whom many bones are involved is very great.	Much less.
Specific treatment useful.	Of no benefit.
In the first stage there is exuberant calcification of the ossifying cartilage, causing necrosis of the new-formed tissue and a consecutive inflammation, which terminates in the separation of the epiphyses.[1]	This is less marked. There is often formed instead a soft and non-calcified osteoid tissue.

Syphilitic dactylitis commonly develops in infants. The infiltration may affect the subcutaneous and periarticular tissue, or the disease may begin in the bone or periosteum and later involve the fibrous structures about the joints.

The deep form is a specific osteomyelitis, and often destroys the bone and the articulation. The articular ends of the first phalanges are usually affected.

Symptoms.—Syphilitic dactylitis is characterized by the appearance of an ill-defined, fusiform, purplish swelling, which softens, breaks down, and discharges. The lesions are often multiple, painless, affect the fingers rather than the toes, and in the more serious forms lead to destruction of tissue and marked interference with growth.

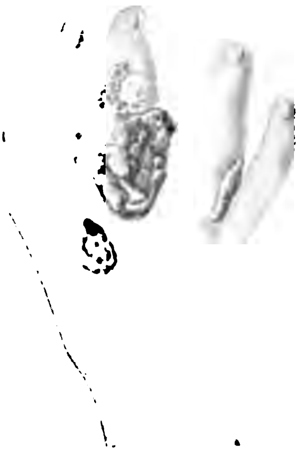
---

[1] This table is founded on one published in the translation of Cornil on Syphilis, by Drs. Simes and White, and is compiled chiefly from the excellent work of Dr. Taylor on this subject.

Diagnosis.—Specific dactylitis must be differentiated from felon, from rheumatoid arthritis, from enchondroma and exostoses, and from tubercular diseases.

Felon exhibits the symptoms of acute inflammation, and is rapid in its course. Rheumatoid arthritis begins primarily in the joints, and is associated with other characteristic symptoms. Enchondroma and exostoses develop much more slowly, and are more circumscribed.

FIG. 313.



Syphilitic dactylitis.

Tubercular dactylitis runs a slower course, is rarely symmetrical, sometimes shows the bacilli of tuberculosis, is not benefited by specific treatment, and disappears very slowly.

The treatment consists in the administration of mercury and the iodides, combined with curetting or resection when abscesses have formed and dead bone is present.

The Joints.—Fournier describes a form of joint-involvement which he terms arthralgia, characterized simply by pain. It is apparently causeless, is irregular in onset, varies in degree, and has a tendency to become more severe at nights.

The lesions of the joints are practically the same as those of acquired syphilis. Fournier describes three forms of arthrosis. The first presents the appearance of simple chronic hydrarthrosis. Close examination shows that the affection of the joint masks a bone-lesion, perhaps an epiphysitis or a periostitis.

The second form presents the symptoms of syphilitic white swelling. There is a somewhat globular tumefaction, made up almost entirely of an extensive hyperostosis of the epiphyses, aided by moderate synovial effusion. There are no involvement of the integument, discoloration, heat, œdema, or inflammatory symptoms. On palpation the tumor is felt to be of bony hardness. It is not sensitive and does not occasion pain. Function is not materially interfered with.

The third form presents deforming arthropathies dependent upon epiphyseal malformation. The shape of the swelling is irregular and at times extraordinary. Osteophytes materially interfere with function, and sometimes occasion complete ankylosis. When they are developed at an early age they are accompanied by muscular atrophy and arrested development of the affected part.

HEREDITARY SYPHILIS AFFECTING THE LYMPHATIC GLANDS.

The enlargement of the lymphatic glands is painless, slow, and without tendency to suppuration. The anterior cervical group is most commonly affected. The tumors hardly ever attain large size, and remain indefinitely without marked change. The enlarged glands of hereditary syphilis are found in the regions affected by tubercular glandular enlargements, and in the early stage of their evolution exhibit the same symptoms. The absence of ulcerative tendency and of general lymphatic involvement, the permanency of the growth, and the effect of specific treatment make the diagnosis clear.

HEREDITARY SYPHILIS AFFECTING THE NERVE-CENTRES AND NERVES.

The Brain.—The lesions which attack the nerve-centres may appear in the form of endarteritis, diffuse infiltration, or gummata.

When the brain is involved the lesions are usually multiple and diffuse, and give rise to a variety of symptoms.

Paralyses are among the characteristic symptoms. These may be limited or general, but when they are repeated, multiple, or recurrent, and particularly when they involve symmetrical portions of the body, they suggest syphilis. The three clinical types recognized in acquired syphilis are commonly seen in the inherited disease,—*i.e.*,

1. Those characterized by sudden palsies, due to the thrombosis of endarteritis.

2. Those characterized by symptoms of brain-tumors, due to gummatous formations.

3. Those characterized by headache and various functional or convulsive disturbances, such as epilepsy, neuralgia, or chorea, due to periostitis or meningitis.

The following is a *résumé* of Fournier's teaching. The lesions of the cerebrum may involve the encephalon primarily or may extend from neighboring parts. Syphilis is undoubtedly one of the causes of hydrocephalus. Infiltrations and gummata of the brain and its meninges have been observed at birth. If the child survives these lesions they manifest themselves later by paralysis, paresis, or enfeebled cerebration, shown by a certain mental incapacity or slowness, or even by actual imbecility or idiocy. Children thus afflicted develop slowly, talk late and with difficulty, are forgetful, and are characterized as backward; or they exhibit no reasoning power, speak at most a few incoherent words, are subject to fits of ungovernable rage, and often suffer from associated defects of vision and permanent or transient muscular incoördination, shown by awkwardness, tremors, weakness of the legs, staggering gait, etc. These pronounced cases are rare, because lesions sufficient to produce them are nearly always fatal in early life.

Cerebral syphilis manifesting itself after the period of infancy (late hereditary syphilis) may exhibit as its cardinal symptoms—

1. Convulsions epileptic in type.
2. Cephalalgia.
3. Disturbed cerebration.

EPILEPTIC SYMPTOMS.—These may develop as pure epilepsy, characterized by a succession of convulsive attacks, coming on suddenly in the midst of apparently perfect health, or by epilepsy associated with other symptoms, such as recurrent, intermittent headaches, heaviness, vertigo, and enfeebled intellect. As the disease progresses, symptoms of cerebral congestion develop, characterized by vertigo, tinnitus, amblyopia, loss of vivacity, dulness, inaptitude for talking or for work, loss of memory, enfeeblement of reasoning power, hebetude, paresis or partial paralysis, particularly of the ocular muscles, and finally hemiplegia. In this form of the disease treatment inaugurated during the epileptic stage, before the advent of other cerebral symptoms, is almost certainly curative. When the disease is well advanced and paresis developed, the prognosis must be extremely guarded.

CEPHALALGIA.—The forms of hereditary syphilis characterized in the beginning by cephalalgia as the major, often the sole, symptom are well authenticated. The pain is general, dull, and heavy rather than lancinating and neuralgic, and involves the whole head. It is subject to nocturnal exacerbations, and is persistent. This latter quality is most important from a diagnostic stand-point. It is shortly followed by other symptoms, especially epileptic crises, the latter appearing in a few weeks.

DISTURBED CEREBRATION.—The third form of cerebral syphilis, characterized by disturbance of the intelligence, usually coexists with other cerebral phenomena. Occasionally it appears as the first and for a time the only cerebral manifestation of the disease. It may be expressed in the form of intellectual asthenia, the child losing the faculty of attention and becoming petulant, forgetful, easily fatigued, dull, heavy, lethargic, even torpid. After several weeks or months, headaches develop, followed by symptoms of congestion and epileptic seizures.

In whatever form the disease begins, if unchecked it ends in disturbance of the intellect and paresis or paralysis. Its course may be rapid, corresponding to the symptomatology of acute or subacute meningitis or cerebral tumors, or may be chronic, lasting for several years.

Diagnosis.—The diagnosis of cerebral syphilis from tubercular meningitis is sometimes impossible. It may generally be founded upon the following points:

1. Cerebral syphilis is not accompanied by fever; tubercular meningitis exhibits fever in the initial period, and in the course of the disease shows characteristic oscillations of temperature.
2. Cerebral syphilis does not cause sudden changes in the color of the face from pale to red, retraction of the belly, irregularity of the pulse. Disordered relation between pulse and temperature is characteristic of tubercular meningitis.
3. The hydrocephalic cry, obstinate constipation in the beginning of the attack, vomiting, delirium, photophobia, chewing, grinding of the teeth, and opisthotonos are much more frequently observed in tubercular meningitis than in cerebral syphilis.
4. Tubercular meningitis often rapidly and markedly affects the general condition, causing emaciation and the symptoms of serious illness. The same changes are not so prominent in cerebral syphilis.

The diagnosis of syphilitic epilepsy from epilepsy due to other causes, one of cardinal importance to establish, will depend upon the rapid development of other cerebral symptoms characteristic of hereditary syphilis. Thus, disturbances of the intellect are early observed; frequently partial palsy follows the attacks in the early stages. Moreover, in the intervals of the attack there are found symptoms of cerebral involvement. All these symptoms develop slowly in true epilepsy. Finally, epileptic attacks which are frequent and multiple in the early stages, or which are partial and lateralized, are much more characteristic of syphilis than of common epilepsy.

It is apparent that cerebral syphilis has no individual symptoms of its own: hence the diagnosis will in the main be founded upon hereditary specific antecedents.

The Spinal Cord.—Gummatous infiltration, as in acquired syphilis, may involve the membranes or the cord itself. These lesions may be secondary to bone-involvement; the first symptom is usually paralysis of the legs. When the seat of involvement is high up this palsy may involve the arms also.

The diagnosis will be founded upon the history and the associated signs of the disease. Fournier summarizes the matter by stating that certain paraplegias of infancy or even of the adult can originate from hereditary syphilis. Tabes, he states, may have the same etiology, since it is so frequently associated with syphilis of the adult, and clinical observation of a limited number of cases seems to establish this fact.

Disseminated sclerosis, he holds, is much more frequent in infancy and youth than is generally believed. It offers practically the same symptomatology as in the adult, and among the etiological factors syphilis must be admitted as an important one in certain cases. Fournier has observed as the result of hereditary syphilis isolated palsy of the oculo-motor nerve, and quotes Nettleship's case of paralysis of the common oculo-motor, the abducens, and the trigeminal nerve. Ormerod is also quoted as observing a case of palsy of the median nerve with gummatous swelling of the trunk.

HEREDITARY SYPHILIS AFFECTING THE VISCERA.

The Lungs.—The lungs are more frequently attacked by hereditary than by acquired syphilis. The disease may appear as gummata or as a diffuse infiltration.

Gummata of the lungs, the common form of involvement, affect chiefly the middle and lower posterior portions, appearing as miliary, pea-sized, sometimes cherry-sized, nodules.

Diffuse infiltration, the so-called white pneumonia, is often associated with gummata. It may involve several lobules or lobes. The portion of the lung affected is dense and of a lighter color than normal, due in part to the anæmia incident to perivascular connective-tissue growth with thickening of the vessel-coats. The alveoli are filled with epithelial cells undergoing fatty degeneration. Diffuse infiltration, if extensive, is necessarily fatal at birth. Apparently children suffering from this lesion, even though it be limited, live but a few days or weeks.

Diagnosis.—The diagnosis of specific lung-involvement in syphilitic infants cannot be made. Many such infants perish of broncho-pneumonia; this, however, is an expression of vulnerability rather than of the localization of a specific lesion.

The Liver.—Examinations of children still-born because of hereditary syphilis show that lesions of the liver are most constant. The liver may be the only viscus involved. The usual form is a diffuse interstitial hepatitis, though true gummatous hepatitis may be observed at birth. There is marked enlargement, the liver, always disproportionately large in young children, being sometimes three or four times its normal size.

The only symptom which excites attention is the enlargement. Exceptionally, from obliteration of the bile-ducts, jaundice develops.

The Spleen.—The spleen is enlarged at birth or shortly after in about twenty per cent. of the cases of hereditary syphilis. The lesion usually appears in the form of diffuse interstitial splenitis, and may form a tumor three times the size of the normal organ. The increase in size seems to be mainly due to a simple hyperæmia. Enlargement of the spleen is a valuable aid to diagnosis. Moreover, the amount and persistence of the swelling give an approximate indication of the severity of the case. Liver-enlargement is of little value as a confirmatory symptom, because, as has just been said, the liver is disproportionately large in infancy and it is difficult to state the limit beyond which abnormality begins. Moreover, causes other than congenital syphilis lead to its enlargement.

The importance of splenic enlargement is greatest when noticed early, —the first three months after birth,—since at this period enlargement of the spleen due to rachitis can hardly come into question.

The Pancreas.—Diffuse interstitial infiltration of the pancreas has been found in a certain percentage of the more malignant cases of hereditary syphilis. There are probably no symptoms which will assist in the detection of this involvement during life, and it is always associated with lesions of other organs far more serious and demanding more immediate attention.

The Intestines.—During the early secondary period lesions corresponding in type to those appearing on the skin may attack the intestines. The passage of blood by the bowel would probably be the only sign on which a diagnosis could be formed. Ulcerating, gummatous infiltrations, rare in any event, are more common in congenital than in acquired syphilis, though it must be remembered that this statement is founded on examinations of malignant and fatal cases of congenital syphilis.

The Kidneys.—Cassell reports six cases of albuminuria in thirty-one infants with inherited syphilis. Interstitial and peri-adventitial proliferation and cystic degeneration of the glomeruli were the lesions found.

HEREDITARY SYPHILIS AFFECTING THE TESTICLES.

This rare manifestation of hereditary syphilis usually develops in the first year of life. The testicle slowly and painlessly enlarges. The epididymis may be involved in the swelling, and there may be an associated hydrocele. Softening and ulceration rarely occur, resolution ultimately taking place, often followed by pronounced atrophy of the gland.

Diagnosis.—Non-traumatic enlargement of the testicle in infancy should always suggest syphilis or tuberculosis. If the tumor never reaches great size, shows no tendency to ulcerate, and primarily attacks the testes, it is probably syphilitic.

Prompt treatment will prevent atrophy.

DIAGNOSIS OF INHERITED SYPHILIS.

In reviewing the general course of a case of inherited syphilis it becomes evident that the differences between it and the acquired disease are seeming rather than real. The primary stage in inherited syphilis is of course wanting, and the tertiary stage is apt to appear unusually early.

Early Hereditary Syphilis.—The diagnosis of inherited syphilis in its early stages, at birth and shortly after, will be founded on,—

1. A history of parental syphilis. The probability of the transmission of the disease is increased if the parental syphilis was recent at the time of conception and if both parents were infected.

2. A history of abortions or miscarriages on the part of the mother, particularly if such accidents have been frequent, or of the successive births of several living children who survived but a short time.

3. A fœtus or still-born child showing (*a*) osteochondritis, readily detected by splitting the long bones, particularly the radius, ulna, humerus, tibia, and femur, through the diaphyso-epiphyseal juncture. In place of the regular narrow line marking the apposition of bone to cartilage, there is a broad, irregular, yellow line; (*b*) enlargement of the liver and spleen; (*c*) the lesions of interstitial pulmonitis; true gummata, or catarrhal phenomena, with fatty degeneration; (*d*) papular, pustular, or ulcerating lesions, or bullæ which exhibit the characteristics of syphilitic pemphigus. Maceration of the epidermis and its elevation into bullæ are scarcely characteristic, though distinctly suspicious. (*e*) Arachnitis with hydrocephalus. (*f*) Arrested development and evidence of profound malnutrition.

4. A living child prematurely born, or carried to full term, showing the lesions of syphilis at birth or shortly developing them. Whether the syphilitic child be stunted, emaciated, wizened, and senile at birth, or be well nourished, cutaneous or mucous membrane eruptions and other evidences of syphilis are often absent. In a few weeks, or at most two or three months, highly characteristic symptoms develop. The more prominent of these are snuffles, hoarseness of the voice, syphilides of the skin and mucous membrane, enlargement of the liver and spleen, inflammation of the iris, profound cachexia, and specific inflammation at the junction of the epiphyses and diaphyses of the long bones, sometimes producing a condition termed syphilitic pseudo-paralysis.

Upon the presence of these symptoms the diagnosis of hereditary syphilis will be founded in the first year in life.

Prognosis.—The prognosis of early hereditary symptoms is unfavorable if cachexia is marked, if there are intercurrent affections, if the symptoms show themselves early, if the nasal or laryngeal affection is severe, if the eruptions are markedly bullar or pustulo-ulcerative, if the enlargement of the spleen is great, if the osseous lesions are multiple or extensive, and especially if lesions of the tertiary type develop, such as gummata, nodes, etc.

Late Hereditary Syphilis.—After infancy the diagnosis of inherited syphilis will be founded on,—

1. A history of parental or infantile syphilis, or both.

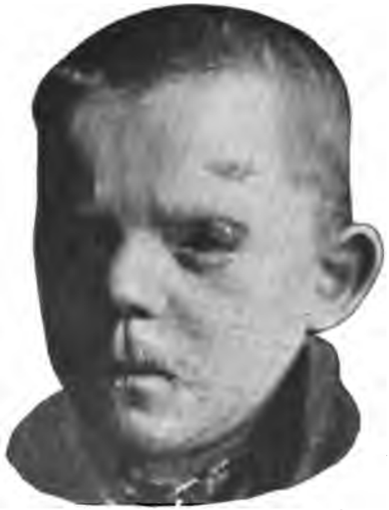
2. Imperfect or arrested development. This is manifested by many symptoms, none of which are individually characteristic, but the association of which is pathognomonic. The common expressions of this developmental retardation or arrest are—

(*a*) A low stature and puny development. The figure is often graceful and symmetrical, suggesting infantilism or early youth long after these periods have passed, or the appearance may be that of premature senility. (*b*) Pasty, leaden, or earthen complexion. (*c*) Dryness or harshness of the hair, and brittleness and splitting of the nails.

3. Active manifestations of syphilis or traces of former characteristic lesions. (*a*) The forehead bulging in the middle line, or bossed in the region of the frontal and parietal eminences. (*b*) A flat, sunken bridge of the nose, due to the coryza of infancy extending to the periosteum of the delicate nasal bones, interfering with their nutrition or partially destroying them. (*c*) Dulness of the iris (rare).

4. Ulceration of the hard palate and pharynx. Thickening or enlargement of the long bones near the ends, or slight angular deformity, the result of the osteochondritis of infancy.

Fig. 314.



Hereditary syphilis. Cicatrices of fissured lips and gummata of the forehead and orbit. (De Schweinitz.)

5. Hutchinson's teeth.

6. Traces of interstitial keratitis.

7. Cicatrices about the lips and nares. These appear in the form of narrow, radiating scars, extending across the mucous membrane of the lips, or as a net-work of linear cicatrices on the upper lip and around the nostrils, as well as at the corners of the mouth and on the lower lip. (Fig. 314.)

8. Skin cicatrices, showing rounded, polycyclic, or serpiginous outlines, especially about the nose and the gluteal region.

9. Periosteal nodes on one or many of the long bones, or irregularly scattered over the skull.

10. Sudden and complete deafness without otorrhœa, or other subjective symptoms, or a history of sudden, painless otorrhœa in childhood.

Prognosis.—The prognosis of late hereditary syphilis is good so far as life is concerned, although exceptionally when important viscera, such as the lungs, the brain, the liver, or the kidneys, are attacked, death may result before treatment can accomplish resolution of the specific infiltrate.

The treatment of hereditary syphilis is given in the following chapter.

CHAPTER XXVIII.

THE TREATMENT OF SYPHILIS.

THE treatment of syphilis is conveniently considered under the following heads:

1. Prophylactic.
2. Abortive.
3. Constitutional.
4. Local.

PROPHYLACTIC TREATMENT.

In discussing the treatment of a disease which is thought to owe its origin to a pathogenic organism, modern science demands consideration of the possibility of preventing the spread of the contagion, or of eradicating it by destroying the source of infection.

The Contagious Diseases Acts of Great Britain and the various laws of other countries for the restriction and regulation of prostitution aim at accomplishing this purpose. They represent the attempts of the governing authority to protect the community at large from disease and infection by regulating the hygiene of and placing restrictions on the class most liable to spread the disease. There can be no doubt that these measures are of great benefit, and it has been proved that clandestine prostitution, out of reach and control of these acts, is the great source of contagion in the countries in which they have been in force.

It may be admitted that no method has as yet been devised which is in all respects unobjectionable or is capable of universal application. It may also be conceded, even while advocating the general principle of supervisory legislation as applied to prostitution, that in the details of every plan yet proposed there has been much that was defective or positively harmful, and that the subject is still one of the unsolved sanitary problems of the age. The direction in which action must be taken, and the general character of that action, may, nevertheless, be indicated, if not demonstrated.

We may begin, without much fear of contradiction, by urging the necessity of a more general and more accurate public knowledge concerning the gravity and the prevalence of this disease. The innocent—who are also in this respect the ignorant—members of the community have claims which we, who seek to fulfil the highest function of our profession,—the preservation of health, individual and national,—cannot conscientiously disregard. Every adult citizen should be aware for his own sake of the possibilities of contamination which surround him; every parent should be competent to protect his wife or children from all indirect infection through a servant or playmate, a household utensil or a toy; every wife should know that by permitting the approaches of a syphilitic husband she herself becomes liable to disease, and to the creation of a being which has few chances for life and still fewer for health and happiness; and every syphilitic should realize that, except after certain intervals and under proper restrictions, his marriage is an outrage to the woman he professes to love and a crime against society.

Once let these facts be clearly understood and this information widely diffused, and an important step will have been taken not only in preventing accidental and guiltless contagion, but also in preparing public opinion for the legislative measures which are believed to be desirable. Another good result would in all probability be a diminution in the number of cases of this class of disease, who, in ignorance of the gravity of their ailment, consult the quacks and irregular practitioners who find here their favorite and lucrative field. It is safe to say that the fees of the patients with venereal disease annually treated by charlatans, advertising doctors, and apothecaries would comfortably support all those younger members of the profession into whose hands they ought naturally to fall and who now pass through the usual struggle for existence.

For these reasons—first and especially the public welfare, and next our own personal interest—we should in every proper way encourage the presentation of this matter to the community at large, by means, for example, of discussions in health societies, by proper representations to editors of the daily press, and by careful but truthful and forcible statements to our friends and patients, who are frequently eager for information on the subject.

It may be admitted at once that if the total abolition of prostitution could be accomplished, and if it could be followed by the conversion of the army of harlots into peaceful housekeepers or sisters of charity, and the transformation of their male patrons into pure, law-abiding citizens and fathers of families, it would be a most satisfactory consummation. No one, however, at the present day, with perhaps the exception of a few impractical clergymen and a number of enthusiastic and well-meaning but misguided women, believes in the possibility of attaining such an end. The accumulated experience of mankind constitutes a wall of unanswerable argument. All attempts at the extinction of prostitution present throughout the centuries one unbroken record of failure. Wherever this scheme has been tried, the sexual impulse, the strongest to which human nature is subject, has asserted itself, and other laws have been violated, other and graver evils have resulted. The remedy has proved worse than the disease. (Lecky.) Seduction, illegitimacy, criminal abortion, and infanticide have invariably followed, and the total average mortality of the community has been seriously increased.

In considering the necessity for general prophylaxis and the direction which efforts towards the accomplishment of this end should take, it should be remembered:

1. That syphilis is of great antiquity, and is likely to continue indefinitely. 2. That this disease already affects a large number of the population, and that by means of its many forms of inoculation and transmission it is rapidly spreading still farther. 3. That the existing means for its treatment among the poorer classes are insufficient, and that the establishment of institutions for that purpose or the endowment of special wards in our general hospitals is a measure eminently worthy of the attention of the public-spirited and benevolent. 4. That its most common mode of propagation is by irregular or illicit sexual intercourse, and that therefore we should turn our main efforts at prevention in this direction, while endeavoring at the same time and in every decent and proper manner to guard the community at large from the effects of ignorance. 5. That prostitution, arising in response to the demand for this illicit indulgence, has, like syphilis, existed from time immemorial, and is not likely to disappear. 6. That prostitutes themselves need protection and have claims on the humanity of the law. 7. That by means of supervisory legislation and control of prostitution the unlawful sexual commerce of the world may most readily be restricted and the spread of the disease be prevented. 8. That there is sufficient evidence that such control and restriction, though surrounded with difficulties, is yet possible, and that the advantages to be derived from it are highly important.

The only certain method of escaping the venereal forms of syphilis is the avoidance of exposure. When consulted in regard to prophylaxis the physician should insist upon this point and need not volunteer further information, though under proper circumstances he should not withhold knowledge as to the means by which the danger of contagion can be lessened, if not entirely avoided. This danger can be diminished by (1) avoidance of intercourse when there is an abrasion or any surface break about the genitalia; (2) the use of covers; (3) the local use of protective and antiseptic ointments; (4) thorough local washings with mild antiseptic lotions immediately before and immediately after coitus; (5) circumcision in persons with redundant or phimotic foreskins; (6) the use of astringents by those whose mucous membrane is particularly vulnerable; (7) immediate antiseptic applications to and superficial cauterization of abrasions acquired during coitus.

The risks of extragenital infection are lessened by (1) the avoidance of prolonged contact of any portions of the body; this particularly holds true of the lips and tongue; (2) care as to the cleanliness of eating and drinking utensils, pipes, or any article which is liable to be contaminated by the discharge from the lesions of syphilitics; (3) the immediate cauterization of any abrasion or wound which could possibly have been infected by the discharges from syphilitic ulcers, mucous patches, etc.

Perhaps the most important means of prophylaxis is thoroughly to impress upon those who are suffering from florid syphilis the fact that all their bodily secretions are liable to be contagious. They must be instructed as to the possibility of infecting others from cigars, spoons, forks, or other articles moistened with their saliva, or from razors, manicure instruments, scissors, or knives which may be stained by their blood, and from handkerchiefs, sheets, pillow-cases, garments, towels, sponges, or baths which may contain the virulent discharge from mucous membrane or skin lesions.

The danger of conveying the contagion by kissing, by intercourse, or by body contact of any kind must be clearly laid down.

In the case of a surgeon, accoucheur, or dentist, the possibility of infecting patients by means of the blood incident to accidental wounds of the hands must be duly considered; indeed, this danger is sufficiently pronounced to forbid the performance of difficult or extensive operations during the florid stage of the disease.

As further means of prophylaxis, barbers, masseurs, chiropodists, all whose occupation requires them to treat the skin and its appendages by instruments or by the hands, should be thoroughly instructed as to the possibility of conveying the disease. They should be required to sterilize their instruments by heat or other efficient means before using them on each new client, and should be held legally responsible for cases of syphilis which develop in consequence of their ignorance or neglect of simple precautions.

THE ABORTIVE TREATMENT.

Two methods have been proposed for the abortion of syphilis immediately upon the appearance of chancre; these are—

1. The excision or complete destruction of the chancre and the surrounding tissues.

2. Destruction of the specific virus by active constitutional treatment.

Excision or Destruction of the Chancre.—The abortion of syphilis by excision, cauterization, or injection of the chancre has been attempted in many hundreds of cases, but efforts in this direction have almost without exception proved futile. In a very few of the many reported cases excision seemed to be successful in preventing the development of constitutional disease; but it is possible that constitutional syphilis would not have developed even if the operation had not been undertaken, since the course of untreated cases shows that a certain small percentage of undoubted chancres is not followed by secondary manifestations.

Aside from the attempt to abort syphilis, excision of the chancre may be undertaken with the idea of ridding the system of a focus of infection, or for cosmetic or other reasons, and if total excision does not leave a deforming or crippling scar there can be no objection to it. It must be borne in mind, in considering the results of this operation, that the ulceration of chancre, even though it appear extensive and deep, usually disappears under constitutional treatment, leaving an extremely insignificant scar. Ehler holds that excision of the initial lesion lessens the severity of subsequent symptoms, since thus there is cut off from the system a large amount of infection; he also thinks that in a certain percentage of cases the constitutional disease is completely aborted. Fournier believes that excision gives an average of one success in five cases.

Probably it is safe to assume that when the sore is seen within a few days of its appearance and before the lymphatic vessels and glands in anatomical connection are enlarged, the disease may still be purely local, and constitutional poisoning may be prevented by complete excision of the infected focus: hence such a sore should be removed by excision when it is favorably located for this operation, or should be destroyed by cauterization under other circumstances. When the sore is located upon the prepuce or upon the skin of the genitalia, it, together with the apparently healthy surrounding tissue, may be picked up in a pair of rat-tooth forceps and removed by a cut with a pair of scissors curved on the flat. This wound may be sutured, or, to give greater assurance of the complete destruction of the specific micro-organisms, the raw surface may be cauterized with nitric acid and dressed with iodoform or boric acid powder. When the sore is so situated that its removal by the knife would cause troublesome hemorrhage, deformity, or interference with function, nitric acid or the actual cautery may be employed for its destruction.

As regards protection from subsequent constitutional syphilis, the results are, on the whole, unsatisfactory; but in a few cases—nine in all—we have been able to make observations under unusually satisfactory circumstances. In these cases the patients came promptly upon the development of the sore, and sent for examination the women with whom they had had connection, evidence of syphilis being discovered in the latter. The sores of the male patients were excised and cauterized with nitric acid. In five of these cases microscopical examinations showed that the sores possessed the usual characteristics of hard chancre. In one of them slight glandular involvement had already shown itself; in the others it had not yet appeared. The shortest period intervening between the appearance of the sore and inspection of it was twelve hours; the longest, five days.

In five of the nine cases, including the one in which there was slight glandular involvement, no further symptoms have ever developed; in the remaining four the appearance of constitutional symptoms was delayed from three to five weeks beyond the usual time, just as is the case when mercury is given immediately on the appearance of chancre.

It is only fair to add that, during the time these observations were made, several cases were seen in which excision was not performed on account of the anatomical seat of the sores, which were believed to be almost certainly specific, but which healed and disappeared without the development of the slightest constitutional trouble. Only in one of these latter cases, however, was there an opportunity for confirming the diagnosis by confrontation.

In all cases in which a week or more has elapsed since the development of the sore, and in which involvement of the dorsal lymphatics of the penis or of the inguinal lymphatic glands is observable, cauterization, as a routine method of treatment, should be rejected, on account of its undoubted uselessness at that stage in preventing constitutional disease; the pain which it causes; the inflammatory action which follows it, and which often produces enough œdema and swelling to cause phimosis, and thus convert an open sore into a hidden one; the subsequent effusion of lymph, which simulates true induration and confuses the diagnosis; and, finally, the greater liability to the production of suppurative action in the ordinarily indolent bubo of syphilis.

Even though the sore has not been seen for one or two weeks and the inguinal glands are typically enlarged, if situated upon a surface from which it can be removed without resulting deformity, it should be excised, the resulting wound being sutured. When situated entirely on the foreskin, whether seen early or late in its development, total removal by circumcision is desirable.

Constitutional Abortive Treatment.—The evidence points so strongly to the microbic nature of syphilis and to the specific action of mercury in checking the virulence of this microbe that the conclusion as to the value of early administration of the antidote seems unavoidable. Evidence as to the subsequent irregularity and virulence of cases thus treated is greatly overbalanced by the testimony of many competent observers as to the lessened severity of such cases. The question which must be considered, and which should influence the time of administration, is that of diagnosis. Mercury should be given as soon as the diagnosis is made. This can, however, be established only by the appearance of the secondary symptoms, since there is no characteristic of the chancre which is absolutely pathognomonic.

The surgeon who is daily called upon to give an opinion in cases which involve the whole future of the individual, his relations to the other sex, his determination towards celibacy or matrimony, his matrimonial relations if he should be already married, the question of the influence of paternity, the institution of a course of treatment extending over years, the diagnosis of any obscure visceral troubles which he may develop later in life, the profoundly depressing mental effect which a knowledge of syphilitic infection usually has upon intelligent people,—the surgeon who remembers these facts and recalls the views already cited as to the possibility of error should surely hesitate about beginning a course of treatment which may obscure or render altogether impossible the diagnosis.

While it cannot be held that the subsequent course of a case of syphilis is advantageously influenced by delaying specific treatment till the appearance of secondary symptoms, on the other hand, the gain from the immediate treatment during the primary sore is not sufficient to counterbalance the doubt and uncertainty which that treatment often throws about the future life of the patient.

Mercury should not be given till the diagnosis of syphilis is assured by the appearance of secondary symptoms.

There are a few necessary exceptions to this rule, which may be included under the following heads:

Mercury may be given at once—

1. When the sore is distinctly a typical one and confrontation gives confirmatory evidence.

2. When the sore is typical and its continued existence would

destroy or imperil the conjugal relations of two people or possibly the happiness of an entire family.

3. When characteristically indurated sores show a marked tendency to spread and involve important regions.

4. When sores are placed in such conspicuous positions, as upon the lips or the nose, that their continuance would involve a general knowledge of the patient's condition.

5. When sores are placed in such positions, as on the finger of a surgeon or of an obstetrician, that they may lead to the infection of others.

6. When typical sores appear on pregnant women.

With these exceptions, it is the part of wisdom to wait until the development of syphilitic anæmia or of glandular enlargement at some point removed from the initial lesion, and not by any possibility a result of simple adenitis, demonstrates the constitutional character of the trouble. It is not necessary to wait for the syphilodermata. Treatment may be safely begun when, after a suspicious sore upon the genitals, consecutive enlargement of the epitrochlear or postcervical lymphatics follows, or an otherwise inexplicable diminution in hæmoglobin and increase in white corpuscles take place.

The views expressed as to the abortive treatment of syphilis may be summarized as follows:

1. Chancres which are seen early (before lymphatic involvement), and especially when diagnosis is confirmed by confrontation, should be widely excised or cauterized in accordance with their position. Chancres on the prepuce call for circumcision. There is a sufficient chance of abortion or attenuation of the disease to justify the adoption of these measures. 2. Thorough antiseptic treatment of chancres can have no abortive effect, but is valuable as a means of preventing mixed infection. 3. While it must be admitted that mercury should be administered as early as possible, the advantages incident to this early treatment do not warrant its inauguration before the diagnosis is absolutely sure. 4. This diagnosis can be absolutely assured only by the appearance of some general symptoms, such as blood-changes, enlargement of distant lymphatic glands, or roseola: hence the administration of mercury for the purpose of aborting syphilis on the basis of a diagnosis founded on the presence of the chancre alone is not advisable, unless this diagnosis is still further confirmed by confrontation, or unless there are urgent reasons for attempting to cure a doubtful sore as rapidly as possible.

THE CONSTITUTIONAL TREATMENT OF SYPHILIS.

The reasons for waiting until the appearance of constitutional symptoms before administering mercury have already been given, and also the exceptional circumstances under which such treatment may be started in the primary period of syphilis. The constitutional infection may be first manifested by a rash, general lymphatic involvement, muscular, neuralgic, or bone pains, anæmia, or the so-called syphilitic fever, though commonly the rash is the most characteristic and most easily recognized sign of systemic involvement on which the surgeon can base his diagnosis.

During the period of waiting for the development of constitutional symptoms the general health of the patient should be carefully regulated. He must be warned as to the importance of avoiding overwork, mental strain, undue exposure, and excesses of all kinds. He should eschew strong alcoholic drinks, but need not be prohibited from moderate indulgence in light wines at meals. He should be cautioned that the use of tobacco distinctly predisposes to lesions of the mouth and throat, and should be advised to give up the use of this drug in all its forms.

The hereditary tendencies and diathesis of each individual should be studied, since every depressing influence by lessening cell-resistance may lead to increased virulence of the disease. Tuberculosis in the form clinically recognized as struma particularly favors virulent manifestations of syphilis, such as deep and obstinate ulceration, ostitis, caries, and various visceral changes. A tubercular family history should, therefore, be regarded as a special indication for hygienic precautions. A patient with such a history should spend at least a part of each summer at the sea-shore or in the mountain air, should avoid all causes of local congestion, such as chilling of the surface, and particularly should guard against bruises, sprains, or other traumatisms, slight in themselves, but strongly predisposing to the local development of strumous and of syphilitic lesions. The diet should be rich, of digestible fats, and carbohydrates. Pulmonary gymnastics should be employed, and to the specific treatment should be added emulsions of partly digested cod-liver oil in combination with ferrous iodide or the hypophosphites.

Both the gouty and the rheumatic diathesis exert a distinctly unfavorable influence on the course of syphilis. They predispose to vascular degeneration, to cerebral disease secondary to endarteritis, to troublesome papulo-squamous syphilides, to iritis, to periosteal nodes and various other affections of the fibrous tissue. The diet of such patients should be most carefully regulated. They should be told to eat sparingly of dark meats and of sugars, to drink freely of potash or lithia waters, and to eschew sweet wines, malt liquors, etc. In combination with the above treatment, short courses of salicylates may be advantageously employed, and the iodides should be begun much earlier than in the case of previously healthy patients.

Patients of a neurotic type seem to be especially predisposed to affections of the brain and spinal cord. The preliminary advice in such cases must be directed to the avoidance of worry and mental strain of any kind. Every effort should be made to prevent that state of nervous depression which the knowledge of having contracted syphilis so often occasions. Rest to the mind, and diversions of various kinds, particularly those which require mild exercise, such as horseback riding, cycling, golf, and long summer vacations spent in the open air, should be insisted upon. The treatment should be unobtrusive, the prognosis to the patient hopeful. Long hours of rest are particularly desirable. The specific treatment may be advantageously supplemented by strychnine and the hypophosphites.

In all patients, whether robust or weak, the hygiene of the mouth, of the gastro-intestinal tract, and of the skin should receive particular attention, and invariably repeated examinations of the urine should be made to determine whether or not the kidneys can be depended on for the elimination of mercury and possibly the toxic products of the syphilitic virus.

The teeth should be put in perfect order by a competent dentist, and should be kept scrupulously clean through the entire course of treatment by cleansing washes, astringent mildly antiseptic powders, and careful removal of particles of food by means of toothpicks and dental floss immediately after eating. Upon the health of the mucous membrane of the mouth depends to a great extent the ability of the patient to take an efficient quantity of mercury without causing salivation.

The gastro-intestinal tract must be kept free from irritation by well-regulated diet, by digestive and antiseptic powders, and by mild laxatives when indicated. Only when the stomach and bowels are in good condition can the full dose of mercury be taken by the mouth and be absorbed without exciting symptoms of gastro-intestinal catarrh. The bowels aid in the elimination of mercury.

The skin also aids in eliminating mercury. It should be kept in perfect health by daily bathing and friction, hot or cold water being employed in accordance with the feelings of the patient. Hot plunge baths, Turkish baths, and hot-air baths are to be advised, unless marked vascular degenerations contra-indicate their employment.

When the time has come for the administration of mercury, it may be employed in accordance with one of the following methods:

1. It may be given only when required to cause the disappearance of actual symptoms.
2. It may be given interruptedly in periods of varying length, with intervals of complete rest between.
3. It may be given continuously over long periods of time.

Modified Expectant Treatment.—The first method, termed the modified expectant plan of treatment, has but little to commend it, if we accept the germicidal theory of syphilis, if we believe that the effects of the disease are wide-spread and permanent, and that these effects are dependent largely on the relation between the original dose of the micro-organism and the resisting power of the normal cells, and if we also believe that mercury exerts an inhibiting or toxic effect on the specific micro-organism.

Interrupted treatment of syphilis is worthy of serious consideration mainly because it is advocated by Fournier. He, however, has frequently changed his method, and this fact apparently shows that the intermittent course has often failed to produce permanent cures.

Taylor holds that the time to eradicate syphilis is at the beginning of the attack, when vigorous mercurial treatment is best tolerated and is most efficient. If the treatment is pushed for about six months he believes that most cases will be found on their way to recovery, and may then have a rest in the absence of lesions and if the general health is well maintained. After a month without specific treatment a course of inunctions, or a combination of mercury and small doses of potassium iodide, is given. Taylor argues against the continuous plan of treatment, on the ground that mercury administered by the stomach induces a condition of tolerance and after a time has no beneficial effect.

Continuous Treatment.—This is the most rational treatment of syphilis, and is the one which is generally adopted. Mercury is administered without interruption for a period varying between one and three years, and in as full doses as the patient can tolerate without prejudice to general health. It is advisable to use the same preparation of mercury throughout the treatment. The dose is regulated by the patient's susceptibility. Beginning with the protiodide, for instance, a third of a grain thrice daily, this quantity is gradually increased till slight toxic symptoms develop. The first symptoms caused by full dosage of the protiodide may be griping pains in the abdomen and several watery stools a day. When other preparations of mercury are given, and often with the protiodides, fetor of the breath, hypersecretion and ropiness of the saliva, and slight gum tenderness may be the first indications that the drug has been pushed to the limit of safety. When it is thus determined how much of the mercurial preparation of choice a patient can take safely, provided the symptoms of impending salivation are slight, the full dosage is continued a short time until the more active manifestations of the disease have been combated; it is then cut down one-half, and this lessened dose, or one-half the quantity required to produce salivation, is the quantity he is to take through the greater part of his treatment. After the limit of tolerance has been determined, if the symptoms are not active, the patient is given a rest of several days, until the constitutional effects of mercury have entirely disappeared; he is then put on the half dose, and this is continued for about two and a half years. In certain cases the quantity given may be still further reduced to one-third the full dose. Frequently, as a result of treatment, there is an increase in general health, markedly beyond the degree enjoyed before syphilitic infection.

SYSTEMATIC TREATMENT OF SYPHILIS.

As a result of many years of experience in large venereal hospital services and a somewhat exceptionally rich clientèle in private practice, we have adopted the following routine method of treating syphilis.

The general hygienic treatment already described (pages 1009, 1010) is inaugurated at once; in addition, the patient's weight is recorded and repeated quantitative and qualitative examinations of the urine are made.

As to the preparation of mercury which is to be administered, the protiodide is preferable for routine use, because clinically it has been efficient, and possibly because the small amount of iodine which the salt contains may be advantageous. Corrosive sublimate and mercury with chalk will also give excellent results, and sometimes can be taken without irritation when the protiodide markedly disagrees. Blue pill and calomel have not been satisfactory.

As a routine practice it is well to adhere to the administration of the protiodide, the bichloride, or gray powder, preference being given to the first drug, the others being employed only when the protiodide produces undue irritation without favorably influencing the course of the disease.

When few remedies are tried by the surgeon he becomes more familiar with their strength and special properties, and hence is more likely to employ them skilfully than if he used many salts of mercury, the special reactions of which are unknown to him.

If the protiodide is selected, the following prescription may be ordered:

℞ Hydrarg. iodid. flav., ℈i;
Confect. ros., q. s.
M. et ft. pil. no. lx.

The patient is directed to take three pills on the first day, four on the second, five on the third, and so increase the dose by one pill daily until some characteristic toxic effect of the drug is produced. While thus pushing mercury for the purpose of discovering the full dose, the patient must be seen at least every second day, and there must be some standard adopted by which his susceptibility to the drug may be determined,—that is, some characteristic symptom must be sought for.

The patient's reaction to the drug is most certainly shown by the condition of the mouth and gums. Mild colicky diarrhœa is frequently considered a sign that the full dose of mercury has been reached; this symptom, however, shows only the reaction of the intestinal mucous membrane to the particular preparation of mercury that is being used. Colic and diarrhœa may occur long before enough mercury has been given to influence the gums, or even enough to influence the course of early syphilis. These symptoms indicate defective absorption of the drug, and show that only a fractional part of the daily dose administered is reaching the general circulation: hence the adoption of colicky diarrhœa as a gauge of constitutional susceptibility may lead to error, and may result in insufficient treatment and its disastrous consequences.

If during early treatment colic and diarrhœa develop before the first symptoms of ptyalism, the protiodide should be withdrawn, and in its place pills of mercury and chalk should be administered:

℞ Hydrarg. cum creta, ʒi;
Ft. pil. no. lx.

These pills are administered exactly as are those of protiodide of mercury, increasing steadily until the limit of tolerance—*i.e.*, the minimum dose necessary to produce toxic symptoms—is determined. A grain of mercury and chalk produces a somewhat more powerful effect than the third of a grain of protiodide.

If the gastro-intestinal irritation persists, unaccompanied by symptoms of ptyalism, bichloride of mercury should be administered:

℞ Hydrarg. chlorid. corrosiv., gr. iv;
Confect. ros., q. s.
M. et ft. pil. no. lx.

or

℞ Hydrarg. chlorid. corrosiv., gr. ii;
Mucilag. acaciæ,
Aquæ, āā ℥ii.
M. S.—Teaspoonful freely diluted, as directed.

If the change to these prescriptions is not successful in subduing the symptoms of gastro-intestinal irritation, inunctions must be employed.

When the patient is so situated that it is impossible for him to take inunctions, opium in sufficient quantity to control the diarrhœa may be combined with one or other of the formulæ already given until the full dose is determined. It should then be withdrawn, since it tends to constipate, to reduce appetite, and generally to influence the system unfavorably. Moreover, it renders uncertain the amount of mercury actually being absorbed, and this is a disadvantage of cardinal importance, *since the essential point in the treatment of syphilis is the administration during a sufficiently long period of the largest dose of mercury which can be taken and absorbed without prejudice to the general health.* Merely to order that a certain dose of mercury be swallowed and to provide for its safe escort under an opiate guard from one end of the alimentary tract to the other, is not to treat syphilis intelligently.

The best method of administering opium, when this is required to determine the full dose, is in the form of paregoric. With each mercurial pill the patient is directed to take the smallest number of drops which will prevent griping diarrhœa; thus the minimum efficient quantity can be found and can be administered in a form towards which the stomach is fairly tolerant.

It must be clearly borne in mind that salivation is never to be produced, and that the drug is pushed only until the premonitory symptoms develop. These are: 1, a thickening of the saliva and an increase in its quantity; 2, boggy swelling of the gums around the teeth, and a tendency to bleed on slight irritation,—so-called sponginess of the gums; 3, slight tenderness of the teeth when they are snapped together, and a feeling as though they were somewhat longer than they should be; 4, a metallic taste in the mouth; 5, fetor of the breath.

It is only when the mouth and teeth are clean that these symptoms are valuable as an index that the system is taking all the mercury it can absorb without producing marked toxic effects. When the teeth are dirty, caked with tartar, decayed, and clogged with masses of decomposing organic matter, from carelessness in the use of tooth-brush and tooth-washes, or from neglect in seeking the aid of the dentist, salivation will occur from doses of mercury far below those necessary to saturate the system to the limit of safety. Under such circumstances it is well to wait until the mouth has received proper attention before attempting to find the minimum toxic dose of the drug.

When one or all of these symptoms appear, the dose should be reduced at once, first to two-thirds, later to one-half that dose, if the persistence of the mouth symptoms indicates further reduction. This is the standard dose, which must be continued, except at certain intervals shortly to be mentioned, over a period varying from two to three years. If during this time there is an outbreak of syphilis, no matter how mild or insignificant, the dose should be increased to the full dose,—*i.e.*, that under which ptyalism began to appear,—and this should be continued until the symptoms vanish, or until salivation is so distinctly threatening that diminution of the dose again is necessary.

When during the course of treatment the mucous membrane of the mouth becomes sore or the gums boggy, cleansing or antiseptic mouth-washes, such as saturated solution of potassium chlorate, alternating with one of boric acid, listerine and water equal parts of each, or phénol sodique one part, water four parts, are indicated; and indeed such mouth-washes should be repeatedly used during the whole course of syphilitic treatment, since they have a marked prophylactic influence against the development of salivation.

The weight during the course of treatment should be carefully noted. This should be taken at the first visit, and should be recorded subsequently at regular intervals. Stationary or increasing weight is favorable. A decrease without obvious cause should occasion grave apprehensions as to the subsequent course of the disease, especially when this decrease is rapid and progressive.

Under the course of treatment just described there is usually steady, often rapid, subsidence of all symptoms. Glandular adenopathy diminishes, and often disappears completely, though there may remain traces of the original swelling; the eruption fades, and the agonizing pains and high temperature which sometimes usher in the secondaries subside promptly.

The end to be obtained is *full treatment over a long period.* By way of making certain that a proper amount of mercury is being absorbed, the internal administration of the drug is stopped at the end of six weeks, and a two weeks' course of inunction in equivalent dose (one scruple to two drachms of mercurial ointment daily) is prescribed. The reasons for this are that absorption from the digestive tract may possibly be diminished in the course of time, and that an interval of rest is frequently beneficial to that tract. After two weeks' inunction the mouth treatment is resumed.

This alternation is continued for a period of two years; that is, during this time there are six months of inunction and eighteen months of internal treatment.

If at any time, however, the syphilitic symptoms persist and resist full doses by the mouth, the latter are withdrawn and inunctions are substituted. In case these fail, hypodermic medication is resorted to.

The Systematic Treatment by Iodides.—Potassium iodide is the preparation commonly employed. The administration of this drug is indicated at the end of the second year, and should be continued for six months in combination with mercury, constituting the *mixed treatment.* No marked germicidal effects can be claimed for the iodides, and the reason for their use is based on clinical rather than theoretical grounds. It is quite certain that their usefulness is not due to an influence exerted on the residue of a prolonged mercurial course by virtue of which that residue is rendered soluble and potent. Indeed, there is evidence that the administration of the iodides actually retards the elimination of mercury.

In the early stages of syphilis they are of little value, their therapeutic efficacy increasing in direct ratio with the age of the disease. The commonly accepted theory in regard to their action is that they powerfully stimulate the absorbent system. The lesions of late tertiary syphilis are particularly characterized by excessive cell-growth and accumulation of imperfectly organized tissue, made up for the most part of a small round-cell infiltrate, and due either to renewal of activity at the seat of former disease, or to a crippling or obliteration of lymphatics incident to the long-continued hyperplasia of the secondary stage. The clinical proof is convincing that iodides are more potent than other drugs in promoting fatty degeneration and absorption of the imperfectly organized exudates.

The iodides may be satisfactorily administered in sarsaparilla as an excipient, not because this exerts any marked alterative effect, but rather because it disguises the taste of the drug. The following formula may be employed in the mixed treatment:

℞ Hydrarg. iodid. rub., gr. iv;
Potassii iodidi, ℥ss;
Syr. sarsaparillæ comp., f℥vi.
M. S.—Teaspoonful in three ounces of water four times daily.

When patients object to taking this prescription, the iodide may be given in the form of saturated solution, one drop of which represents approximately one grain of the potassium iodide:

℞ Potassii iodidi, ʒv;
Aquæ, q. s. ad f℥i.
S.—Five to ten drops three times a day in half a glass of milk or water, increasing the number of drops as required.

Or the iodide may be given in the form of compressed tablets, mercury being administered at the same time, as previously directed. Occasionally other combinations of iodine are better tolerated than the potassium salt, and in certain cases a combination of the three best known salts will be found more serviceable than any one administered singly, thus:

℞ Potassii iodidi,
Sodii iodidi,
Ammonii iodidi, āā gr. xcvi;
Syr. aurantii cort., f℥i;
Aquæ, f℥v.
M. S.—Teaspoonful, freely diluted, four times daily.

When the iodide is given in the form of saturated solution the taste may be almost completely disguised by dropping the required dose in a glass of milk.

When it disagrees with the stomach,—and this is often the case,—it may be combined with essence of pepsin in the proportion of five to ten grains in a teaspoonful. The required dose of this mixture can be poured in half a glass of milk. In a few minutes a junket is formed, which can be properly seasoned, and which completely conceals the disagreeable taste of the iodide. Moreover, when administered in this manner, the stomach becomes tolerant to a remarkable degree. The most important practical point in securing the fullest good effects of the iodides with the least harmful results is to give them in dilute solution. The ordinary dose is given in six to eight ounces of water, and is soon followed by another tumblerful. Hot water still further facilitates the proper absorption of the drug. Iodides should be given about an hour after meals. If they occasion griping pains, tannic acid may be added to the prescription, or the following formula may be used:

℞ Potassii iodidi, ℥ss;
Syr. corticis aurantii, f℥vi.
M. S.—A teaspoonful in water three times daily.

The iodides should be given:

1. In the absence of symptoms, at the expiration of a two years' course of mercury. They should be continued for six months, in combination with mercury (mixed treatment).

2. In precocious secondary syphilis,—that is, when the lesions resemble in type those of the tertiary period, affecting the fibrous or connective tissues, the bones, the nerve-centres, and important viscera, or when they appear in the form of deep ulcers or infiltrations of the skin.

3. In all forms of tertiary syphilis.

The dose of the iodides is, as in the case of mercury, greatly influenced by individual peculiarity. Except when the symptoms are urgent and the integrity of an important organ, such as the brain, is threatened, the initial dose should be five grains three times a day. This should be increased by five grains every third day until the symptoms for which the drug is administered have disappeared, or until toxic symptoms denote that the therapeutic dosage has been passed. In the case of the iodides the production of the toxic symptoms is not indicative that the full physiological or therapeutic effects of the drug have been obtained. To increase the iodides until the symptoms are relieved sometimes leads to the administration of enormous doses, but the evil effects of these are usually far less to be dreaded than the results of insufficiently treated syphilitic lesions of important organs. Thus pushed, the iodides frequently cause the disappearance of osteocopic pains and motor and sensory palsies, and even at times the re-establishment of mental faculties after they have been persistently and to all appearance hopelessly disordered. In doubtful cases large and increasing doses may be administered for diagnostic purposes, though it should not be forgotten that conditions other than those caused by syphilis may be alleviated or cured by full doses of the iodides, thus obscuring the value of the therapeutic test.

The alleged value of tolerance of iodides as a sign of syphilitic dyscrasia is without foundation.

Since mercury and the iodides are drugs habitually used in combating the symptoms of syphilis, and since, if injudiciously administered, they may bring about conditions even worse than those for the cure of which they are given, the toxic symptoms which they occasion must be carefully considered.

The Toxic Effects of Mercury.—Hydrargyrism.—Hydrargyrism may be either acute or chronic. The symptoms of either of these conditions may be occasioned by the introduction of mercury into the system, whether it be by way of the alimentary tract, through the skin, as when the drug is administered by inunction, vaporization, or baths, or through the muscles and subcutaneous tissue, as when preparations of mercury are administered hypodermically. It should be borne in mind that lesions of the kidney particularly predispose to the development of hydrargyrism.

ACUTE HYDRARGYRISM.—The mild form of acute hydrargyrism is that already described, and on its appearance is based the dosage of mercury during the secondary period. The symptoms are a slight ropiness or stringiness of the saliva, with increase in its quantity. During the night there is some flow from the corners of the mouth. The gums are slightly congested, and bleed readily when touched. This is especially noticed about the posterior molars when the teeth are healthy, but is frequently observed at the roots of the lower incisors, since here tartar is prone to collect, and hence the mucous membrane is more vulnerable. When the teeth are snapped together, slight tenderness will be noticed. Close upon these symptoms, often preceding them, come distinct metallic taste in the mouth and fetor of the breath.

If the drug is continued after these symptoms develop, and in some cases even though its ingestion be stopped at once, evidences of salivation become even more pronounced. The gums are greatly swollen and ulcerated. The teeth are loosened, the tongue—indeed, the whole mucous membrane of the mouth—becomes œdematous and congested, and erosions and ulcers appear upon its surface. There is an enormously increased flow of saliva, the submaxillary and parotid glands are swollen, cracks and ulcers appear at the corners of the mouth, and the breath is indescribably foul. In marked cases the patient is unable to masticate, to swallow, or even to speak, and the strength fails rapidly.

In some instances hydrargyrism expends its violence upon the alimentary canal and the kidneys, producing colicky, bloody stools, and albuminuria. This form of poisoning is, however, rare, save when the hypodermic method is employed.

Very exceptionally acute mercurialization appears in the form of skin eruption. This develops as an erythema, a dermatitis, or an eczema rubrum, and is always an expression of idiosyncrasy.

CHRONIC HYDRARGYRISM.—In certain cases the administration of mercury seems to produce a chronic catarrh of the gastro-intestinal mucous membrane. The patient suffers from the characteristic symptoms of this condition, the appetite fails, emaciation is progressive, albuminuria may appear, and there is complaint of great muscular weakness. A profound gloom seizes upon the patient, or he becomes nervous and hysterical. Since absolutely identical symptoms may be produced by the disease for the cure of which mercury is given, the determination of the cause of such symptoms is very important.

When mercury has been administered in comparatively full doses for a long time, and when such symptoms develop and are progressive, it is wise to discontinue the specific drug and to devote particular attention to diet, hygiene, and medication suited to the cure of the gastro-intestinal catarrh. The improvement following such a course of treatment forms the best index to the etiology of the symptoms, though this improvement is always slow.

When such symptoms develop in cases which have been treated by insufficient doses of mercury it may be assumed that they are the effects of syphilis, and that on pushing the drug they will probably disappear. Albuminuria may be due to mercury or to the action of syphilis. The cause can be determined only by the therapeutic test.

The effects of an overdose of mercury on the nervous system are thought by some writers to be as difficult to distinguish from those of syphilis as are the symptoms in connection with the gastro-intestinal tract and the kidneys. Hydrargyrism is said to produce tremblings, attacks resembling epilepsy or apoplexy, cerebral palsies and anæsthesias, cephalalgias and arthralgias, disturbances of sleep, vertigo, and dementia. These symptoms are chronic in type, and yield slowly on cessation of treatment. Fortunately, they are exceedingly uncommon. We have rarely seen any of them.

Treatment.—Salivation is best avoided by minute attention to the hygiene of the mouth and by frequent inspection of the patient, so that the drug may be stopped or its dosage diminished on the development of the first symptoms. When patients cannot be kept under observation they should be told the symptoms of beginning ptyalism, and should be instructed properly to regulate the dose in the event of such symptoms developing. When ptyalism has developed, potassium chlorate and atropine are the most efficient remedies. In conjunction with an astringent mouth-wash, used frequently, the patient is given daily hot, sweating baths, the bowels are opened freely, and the kidneys are encouraged to act by copious draughts of water.

Potassium chlorate is administered in the form of a saturated aqueous solution. A teaspoonful of the salt is added to a glass of water, and the patient is instructed to rinse his mouth with this mixture every few minutes.

In alternation with this a disinfectant and astringent lotion may be employed, such as—

℞ Acid. boric.,
Acid. tannic., āā ℈iv;
Mel. rosæ, f℥ii;
Aquæ, q. s. ad f℥vi.
M. S.—Use as a mouth-wash.

Atropine should be given in small doses, frequently repeated, until some effect upon the pupil is noted. The drug may be administered in powder form, dropped on the tongue, and allowed to dissolve.

℞ Atropinæ sulphat., gr. $\frac{1}{32}$;
Sacch. lactis, q. s.
M. et ft. chart. no. x.
S.—One powder every three or four hours.

In severe forms of salivation ulcerated and eroded patches should be touched with five to ten per cent. solution of silver nitrate, and more powerful antiseptics should be employed, as, for instance, hydrogen peroxide in spray form, phénol sodique, or potassium permanganate 1 to 1000.

The pain incident to taking food may be allayed by painting the gums and eroded patches with a three per cent. solution of cocaine just before eating.

The elimination of mercury from the system is materially hastened by prolonged hot-air or vapor baths, and by the administration of diaphoretics, diuretics, and laxatives.

If the diagnosis of chronic hydrargyrism is assured, withdrawal of the drug and the inauguration of a tonic and stimulating course of treatment are indicated. Change of air and surroundings is particularly serviceable, especially when reinforced by scrupulous attention to hygiene and a carefully selected ferruginous tonic. In case mercury is subsequently indicated, it should not be administered by the mouth.

The Toxic Effects of the Iodides.—Iodism.—Under the general heading iodism are included the various toxic symptoms which may develop in consequence of over-dosage with this drug. Those commonly observed are gastro-intestinal irritation, coryza, pustular skin eruption, lachrymation, tinnitus aurium, and mental depression. Exceptionally neuritis and acute œdema of the larynx are occasioned by comparatively mild doses of the iodides.

As in the case of mercury, iodides are most prone to produce untoward effects in those suffering from kidney degeneration.

The lesions of the iodide dermatoses may simulate almost any of the recognized forms of acute cutaneous eruption. They commonly appear in the form of acne, but erythema, eczema, and herpes are by no means rare. Purpura is frequently observed, and even sloughing, gangrenous ulcers are occasionally noted.

These eruptions are due to idiosyncrasy and bear no definite relation to the dose employed. In some instances small doses produce toxic effects; in others heroic doses are taken with impunity.

In the dose ordinarily employed in the treatment of syphilis a large proportion of patients will exhibit no symptoms whatever from the use of the iodides. A larger proportion will be troubled with a coppery taste in the mouth and with an acneiform eruption, affecting the face by preference, but often widely distributed. Coryza, lachrymation, slight conjunctivitis, and symptoms of indigestion incident to gastro-intestinal catarrh are also common. A very small percentage of the cases will suffer from swelling of the mucous membrane of the larynx and pharynx, sometimes so great as to endanger life, and from an especially severe skin eruption much like furunculosis, which may go on to the purpuric or the sloughing form.

Treatment.—The treatment of iodism depends upon the severity of the symptoms. In the milder cases, and particularly when it is important to continue administering the drug for the purpose of effecting resolution and absorption of syphilitic deposits, the iodide may be continued, or the dose may be slightly increased, since in most cases tolerance is established and the coryza and eruption disappear. A few drops of Fowler's solution may be administered together with the iodides. The gastro-intestinal symptoms are controlled by carefully regulating the diet, administering slightly astringent and antiseptic digestive powders, and giving the iodides largely diluted, preferably in milk to which essence of pepsin has been added. Or, if this method is not feasible, each dose of the drug should be dissolved in a full glass of soda-water, flaxseed tea, or other bland excipient. The tolerance of iodides is by no means indicative of the syphilitic diathesis, nor is extreme sensitiveness to the drug the slightest index as to the absence of the disease.

METHODS OF GIVING MERCURY.

Aside from the dose, which must always depend on individual susceptibility, there are certain definite methods for administering mercury. These are (1) by mouth administration; (2) by inunction; (3) by hypodermic injection; (4) by vaporization; (5) by mercury baths.

Mouth Administration.—The method of administering mercury by the mouth and the choice of preparations have already been indicated.

Though protiodide, gray powder, and bichloride of mercury in varying doses and vehicles are the most valuable drugs for administration by the mouth, there are other combinations of mercury which have received such high professional endorsement that mention of them is not out of place.

The tannate of mercury, recommended particularly by Allen, Petrini, Schwimmer, and Lustgarten, is of value, according to this last author, because it passes through the stomach without being acted upon by the acids therein contained, and when it reaches the duodenum is converted by the alkaline juices of this portion of the intestine into minute metallic globules, which are readily absorbed. The drug is administered in doses of a grain three to five times daily, some simple bitter, such as extract of gentian, being employed as an excipient. The following formula may be ordered:

℞ Hydrarg. tannici oxydulat., gr. iss;
  Acid. tannici,
  Sacch. lact., āā gr. ¾.
M. et ft. in pulv. no. i.
S.—One powder twice or three times daily.

Or tannate of mercury may be given in the form of compressed tablets, each to contain one grain.

The succinimide of mercury has been recommended by Jullien. This is administered in pill form in doses of one-third to one-half grain daily. It is said to cause no gastric symptoms and not to salivate.

Calomel is frequently employed, as in the following prescription:

℞ Hydrarg. chlor. mit., gr. v;
  Sacch. lact., ʒss.
M. et in chart. no. x div.
S.—One powder after each meal.

Carbolate of mercury has been used in doses of one-third of a grain two to six times daily.

Salicylate of mercury is warmly commended as possessing high antiseptic powers, due to the fact that it represents a combination of two germicidal drugs. The dose is the same as for yellow iodide.

Red iodide of mercury, particularly in combination with ipecac, administered in the form of tablets, will, according to Curtis, produce the constitutional influence of mercury without unpleasantly affecting the mucous membranes. One-eighth of a grain of ipecac with one-sixteenth of a grain of red iodide may be given ten to twelve times daily without producing gastric or enteric symptoms.

Zittmann's decoction is an elaborate preparation, containing sarsaparilla, calomel, cinnabar, alum, anise- and fennel-seeds, senna leaves, and liquorice root. The special virtue of this decoction is incident to the elimination produced by diaphoresis and purgation. For details and technique of its administration, see page 1047.

Blue mass is a favorite with many syphilographers. The best combinations of this drug are as follows (Bumstead):

℞ Mass. hydrarg., ℈ii;
Ferri sulph. exsiccat., ℈i;
Ext. opii, gr. v.
M. et in pil. no. xx div.
S.—One pill from two to four times daily.

℞ Mass. hydrarg., ℈i;
Hydrarg. chlorid. mit., ℈ss;
Hydrarg. cum creta, ℈ii;
Ext. opii, gr. v.
M. et in pil. no. xx div.
S.—From two to four pills daily.

The last prescription is ordered when a rapid constitutional effect is desired.

Inunctions are strongly advised by many syphilographers as representing the best method of administering mercury in the routine treatment of syphilis. The objections to this mode are its uncleanliness, the skin irritation which it is liable to excite, and perhaps chiefly the difficulty of applying it without exposing the patient to the risk of having it known that he is being treated for syphilis. Usually, however, a representation of the great advantage of this method as regards the attainment of permanent cure, and especially in relation to the disappearance of existing symptoms, will insure the co-operation of intelligent patients.

The testimony as to the value of inunctions is overwhelming. In all the most successful centres for the cure of syphilis inunction is practically the chief mode of administering mercury. This method has for years been the mainstay for the subduing of violent outbreaks which do not yield to the mouth treatment. After seeing the striking results consequent on its employment in what might be called the emergency treatment, the transition from its occasional to its habitual use in the routine conduct of syphilis is easy and natural.

Whether inunctions are employed for the relief of sudden outbreak, or, as has been recommended, as a means of administering mercury in the intervals of treatment by the mouth, the general hygienic conduct of life should be as rigidly ordered as when the drug is given in pill form; *i.e.*, the mouth should be put in perfect order, the condition of the stomach attended to, etc.

In prescribing inunctions the patient is ordered a mixture of equal parts of mercurial ointment and carbolized cosmoline. Lanolin as an excipient is too gummy, and lard speedily becomes rancid. The undiluted ointment is too irritating, and the oleate is unsatisfactory in its results.

The prescription may be written as follows:

℞ Unguent. hydrarg.,
Unguent. petrolei carbolat., āā ℥i.
M. et in part. no. xvi div.
S.—Use one portion at bedtime.

Each dose may be enclosed in a compressible gelatin capsule or in a cachet of stiff paper. The bulk of this prescription may be somewhat reduced by using the pure mercurial ointment put up in cachets and instructing the patient before using the ointment to anoint with carbolated cosmoline the surface which is to be utilized.

The dose of mercurial ointment for the ordinary healthy adult is from twenty grains to a drachm daily; this can be tolerated for from two to three weeks. If it is long continued without interruption, stomatitis or dermatitis is liable to develop.

The dose of ointment having been settled upon, the patient is instructed as to its application. He should provide himself with woollen underclothing of a thickness suitable to the time of year and of such quality or condition that no great loss will be suffered from its being permanently stained. This set of underclothing should be worn for from three days to a week without being changed.

Whenever practicable, he should do his own rubbing, and before the first dose should take a somewhat prolonged hot bath. He should after his bath and immediately before retiring occupy fully twenty minutes in rubbing in the amount of ointment prescribed for one treatment.

Since this ointment irritates the skin if its application is too frequently repeated in one place, different surfaces are selected on successive nights. These surfaces should be comparatively hairless and fairly accessible. The regions of preference are the inner surfaces of the thighs, the antero-internal surfaces of the arms and forearms, the sides of the thorax, the flanks, and the antero-lateral surfaces of the abdomen; sometimes the buttocks and the soles and inner surfaces of the foot. When the nurse does the rubbing the whole back may be included. By passing from one to the other of these regions in a definite order no one of them need be used oftener than once a week, thus giving plenty of time for the subsidence of any slight irritation which the inunction may occasion.

The patient should not bathe more frequently than twice in the week. If, however, there is marked skin irritation in any particular locality, this whole region is carefully washed with soap and hot water and the following ointment is applied:

℞ Hydrarg. chlorid. mit., ʒii;
Unguent. zinci oxidi,
Unguent. petrolei carbolat., āā ℥ss.
M. et ft. unguent.

Or, if there is no indication for a mild mercurial influence, such as would be exerted by this mixture, the irritated surface is cleansed, dried, and dusted with a mixture of starch and bismuth. Inunctions are taken before going to bed simply as a matter of convenience; they may be given at any time during the twenty-four hours.

Under the routine treatment of syphilis already described this method is enforced for two weeks at a time once in every two months. It may be kept up longer when indicated, and should certainly be continued in the presence of relapsing syphilides of the skin or mucous membranes, or in cases in which the viscera are threatened. In the ordinary benign cases of syphilis, however, it is not necessary to employ this or any other troublesome, tiresome, or painful treatment to the exclusion of the administration of mercury by the mouth.

The portion of this treatment which will be most seriously objectionable to fastidious patients is the continued wearing of soiled underclothing and the avoidance of the regular morning bath. Neither of these conditions is essential to the successful inunction treatment. The patient may be directed to wear the same underclothing only at night, and may be allowed his bath, the residue of the ointment readily coming away under the use of soap or hot water. He can then put on clean underclothes for the day, resuming at night after his next rubbing the undergarments already soiled by the ointment. The continued surface application of that portion of the ointment remaining after all has been rubbed in that the skin will receive seems to be an important feature in bringing about full absorption.

It is undoubtedly true that some persons exhibit an idiosyncrasy against inunctions, eczematous eruptions appearing over the entire body, and in the blonde and thin-skinned the local irritation is sometimes so great that this method of treatment is not applicable.

In place of ointments mercurial soaps have been advised. These are, however, more uncertain in their effects and less accurate in their composition than ointments, and, although cleaner, require more time in their application. Schuster employs a soap commended by Charcot, which is made of equal parts of mercury, mutton suet, and potash soap. These ingredients are gently heated, and to them is added enough potassium hydrate to produce saponification. This mixture is rubbed into the skin for from fifteen to twenty minutes exactly as is mercurial ointment.

Mercury plasters have also been proposed, but have as yet received scanty recognition. Chassaignac employed the emplastrum de Vigo cum mercurio, which contains metallic mercury triturated with styrax and turpentine and added to ordinary lead plaster. Quinquaud obtained excellent results from a calomel plaster made by suspending 1000 parts of calomel in 300 parts of castor oil and adding 3000 parts of melted diachylon plaster. This mixture is spread on linen, is applied to the skin, and is kept on for eight days. The plaster should be about sixteen inches square, and should contain about three drachms of calomel.

Hypodermic Injections.—The specific claims made for this treatment are as follows: (1) A precise dosage is obtainable; (2) it saves time and labor on the part of both physician and patient, visits being rendered infrequent; (3) it necessitates little change of diet or of habits of life; (4) the patient's skin and digestive organs remain unaffected, except in rare instances; stomatitis is exceptional; (5) the disease is readily concealed; (6) there is lessened expense; (7) permanent cure is accomplished in a short time and with a minute amount of mercury; (8) a powerful influence is exerted more readily and surely in the presence of grave and threatening visceral troubles; (9) the time required for a therapeutic diagnosis is shortened in doubtful cases.

Of these various claims the one of most importance is that the disease is permanently cured in a short time. As to this point there is yet no conclusive evidence.

The prompter effect of hypodermic medication in cases of serious visceral troubles may be doubted, as may also the claim in favor of the skin and digestive organs remaining unaffected. It may be fairly questioned whether absorption from the subcutaneous tissues is subject to markedly less variation than that from the gastro-intestinal mucous membrane. The other claims as to the value of this method are unimportant.

The disadvantages of the method are: (1) It is often extremely painful, and is strongly objected to by many patients; (2) it is sometimes followed by dangerous and even rapidly fatal toxic symptoms; (3) it has local sequelæ, such as erythema, cellulitis, abscess, and sloughing; (4) it is a treatment which cannot be carried out by the patient himself, but usually requires frequent intervention on the part of the surgeon.

It would seem fairly clear that the disadvantages of hypodermic medication as a routine treatment more than counterbalance the still unproved advantages, and that it should be reserved for certain exceptional cases shortly to be mentioned.

The drugs employed in the hypodermic method of treatment are either soluble or insoluble. In each class there are many preparations. The two most widely used are corrosive sublimate and calomel.

The technique of the injections is practically the same, independent of the form of mercury employed. The solution or the emulsion must be sterilized, and the surface beneath which the injection is to be driven, the syringe, and the hands of the surgeon must receive the same preparation as though a formal operation were to be performed. The needle should be boiled and the syringe should be washed in boiling water and be soaked in 1 to 20 carbolic solution. For most of the preparations the ordinary hypodermic syringe with a large needle will answer.

Since there are reasons for believing that the local influence of mercury is of great advantage, the existence of a serious lesion in an accessible locality may occasionally determine the site of injection. In the absence of such lesion the injections are usually driven into the upper dorsal or the post-trochanteric region, since these are not subject to pressure or to the observation of others, and are not specially sensitive. Moreover, they are covered by a thick layer of subcutaneous tissue. It is into this rather than the muscular tissue that the injection should be driven, since, if abscess occur, it is much more readily managed when superficial than when subfascial.

The method of throwing in the fluid is like that employed in ordinary injections, except that special precautions are taken against driving insoluble preparations into a vein, since they will probably give rise to pulmonary emboli. This has, indeed, occurred in a number of cases. To avoid this accident, the needle is first thrust in, disconnected from the syringe, and is allowed to remain for a moment, to see if any blood flows through its canal; in the absence of this the injection is driven in. The puncture points are covered, on withdrawal of the needle, by the clean finger of the operator, and are dressed with iodoform collodion. Unless the fluid used is aseptic, cellulitis or abscess will develop.

Most careful antiseptic precautions may not prevent microbic infection, this possibly coming from the deeper layers of the skin.

The pain incident to these injections varies greatly. Occasionally it lasts for hours or even days, and is usually more severe with the insoluble salts of mercury. Tenderness persists for some time, and may be so great as to occasion almost complete disability.

When a soluble preparation—and the best is corrosive sublimate—is employed, the dose is from one-twelfth to one-third of a grain dissolved in about twenty drops of distilled water. A hypodermic containing this quantity of the drug may be administered daily or every second day until premonitory symptoms of stomatitis appear. It may then be given at longer intervals. When on account of its situation an outbreak of syphilis becomes dangerous, as in the brain, and prompt action is imperative, larger doses may be injected.

Sublimate injections are specially indicated when mercury administered by the mouth occasions gastro-intestinal irritation or other untoward symptoms, and when given by inunctions it causes dermatitis. These injections are also indicated when syphilitic lesions are developing in spite of ordinary treatment, when syphilomata are particularly obstinate, and when, in certain cases, on account of intercurrent disease, it is necessary to utilize the stomach for the administration of other drugs. The favorite formula is the following:

℞ Hydrarg. chlor. corros., gr. $4\frac{8}{10}$;
Sodii chlor., gr. iiiss;
Aquæ destil., f℥i.

S.—One per cent. solution of corrosive mercuric chloride. Ten to thirty minims hypodermically.

This solution can be modified by increasing or diminishing the quantity of corrosive chloride, a five per cent. solution being advocated by Lukasiewicz.

Finger employs a one per cent. sublimate solution containing twenty per cent. of common salt.

The succinimide of mercury, the albuminate, the iodo-tannate, the carbolate, the formamide, the benzoate, and other salts have been warmly commended by individual observers.

Of the insoluble salts administered hypodermically, calomel is the type. This is given in doses of one-half to one grain every four days, two grains weekly, or three grains every ten or twelve days. The following formulæ may be employed:

℞ Hydrarg. chlor. mit., gr. ss;
Glycerin. purificat., gtt. x;
Aquæ destil., gtt. x.
M. S.—Use as an injection.

℞ Hydrarg. chlor. mit.,
Sodii chloridi, āā gr. i;
Aquæ destil., gtt. xxx.

The method of using calomel as formulated by Besnier in the Hospital St. Louis is as follows:

℞ Calomel, 1 part;
Vaseline, 20 parts.

The drug is suspended in the excipient as perfectly as possible. The mixture is boiled before being used, and the hands of the operator, the surface into which the injection is to be driven, and the syringe, are sterilized. The region of the buttocks is that of preference. The needle should be an inch in length, and should be driven vertically into the tissues down to the guard by one quick thrust. It should be observed for a moment to see if any blood flows from it, and, if not, the syringe should be attached and the injection driven in slowly.

There is nearly always marked pain, sometimes lasting for hours or days, and this is followed by distinct inflammatory reaction and the formation of a hard, painful nodule, which lasts for two or three weeks.

Severe stomatitis is not infrequently observed; this may progressively grow worse, and in such a case would indicate the excision of the focus into which calomel has been injected. Fatal gastroenteritis has been noted, and embolic pneumonia has developed in consequence of the calomel having been driven into a vein.

As opposed to these evil effects, calomel thus administered exercises a prompt and powerful effect upon the lesions of syphilis, particularly those of the secondary stage of the disease and certain affections of the eye and connective tissues. This effect is prolonged and continued, the calomel presumably remaining at the point of injection as a magazine from which steady absorption goes on.

In the tertiary stage, in conjunction with the iodides, this method of treatment is extremely valuable when the integrity of vital organs is threatened or when the lesions resist ordinary treatment. Among the advantages of the hypodermic administration of calomel should be mentioned its possible diagnostic value in surgical cases. According to Jullien, injections of calomel will quickly determine by their favorable action, or the reverse, whether certain ulcerating neoplasms are syphilitic or malignant. He holds that the therapeutic diagnosis of syphilis may be clearly defined in eight days by injection of calomel.

Metallic mercury is also one of the most popular forms in which the insoluble preparations of the drug are administered. The dose employed is from five to thirty grains once weekly. It is usually given in the form of gray oil (oleum cinereum), prepared by making an ointment of mercury with lanolin as a basis, and then diluting this with almond or olive oil, or by triturating metallic mercury with ethereal tincture of benzoin and oil of vaseline. The object of this preparation is to secure a minute subdivision of the metal and to obtain complete fluidity.

Yellow oxide of mercury is, according to Taylor, the insoluble salt most used hypodermically. This preparation seems to be less irritating than calomel and almost equally efficient. Watrassowski's formula is as follows:

℞ Hydrarg. oxid. flav., gr. xv;
Acaciæ, gr. iv;
Aquæ destil., f℥i.

Of this, fifteen minims are injected at a time.

Of the other insoluble salts of mercury, the neutral salicylate in one or one and a half grain doses weekly, or in half-grain doses every three days; thymol acetate in one and a half grain doses at from three to six days' intervals; the black oxide; the protiodide; the tannate; the sulphate; turpeth mineral, and cinnabar, may be mentioned.

The preparations we have most frequently employed in the hypodermic treatment of syphilis are the one per cent. solution of sublimate (see page 1029) and calomel prepared as follows:

℞ Hydrarg. chlor. mit., ʒi;
Petrolat. liquid. (purificat.), ʒi;
Lanolin., ʒi.
M. S.—Three minims equal calomel gr. i.

The dose of the first preparation is from twenty to thirty minims (one-fifth to one-third grain of sublimate); of the second, three minims. For the latter a special syringe is required.

Both these preparations sometimes caused pain, severe, prolonged, and even incapacitating, although previous injections were painless. When the injections were often repeated the pain became more severe. Even in the comparatively full dosage employed in the use of the soluble preparations—that is, one-fifth to one-third of a grain of sublimate three times a week—symptoms did not disappear so rapidly but that we felt it necessary to employ inunctions and at times internal medication. Most of the injections were given in the dorsal region. In every case, before administering mercury in this manner, careful examination of the urine was made for the purpose of knowing the condition of the kidneys, since in cases of nephritis there is always danger of fatal salivation.

This treatment is so conducted that we know exactly where each injection has been driven in; this is particularly important when insoluble preparations of mercury have been employed, since, in beginning salivation, the foci of injection must be cut down upon at once and any remaining mercury cleaned out. For each patient a chart is made, roughly outlining his dorsal region. Small circles are drawn in the middle of the dorsal region from above downward, representing the first six dorsal spinous processes. The first injection is usually administered half an inch to the right of the spinous process of the first dorsal vertebra, the needle being driven vertically inward. The next injection is given half an inch to the right of the spinous process of the second dorsal vertebra, thus passing down to the sixth, when injections are begun on the left side and continued in the same way. The method of recording the seat of these injections with the rough diagram just described is, of course, obvious. In some cases where the back is extremely sensitive, injections are driven into the buttock, but we notice that in this region they are not less painful.

Value of the Hypodermic Method.—After a careful review of the opinions of the most distinguished syphilographers and a fairly extended trial of the method, it seems safe to assert that the hypodermic treatment of syphilis has not as yet shown results which warrant its adoption as a routine method, to the exclusion of or in preference to other methods, but, on the contrary, has some apparently insuperable disadvantages, and even dangers, which render it improbable that it will ever be so adopted. This does not apply to the employment of hypodermics in exceptional cases.

Indications.—The indications for the use of this method may be summarized as follows. Mercury should be administered hypodermically—

1. In those cases in which other methods of treatment have failed or cannot be applied because of especially sensitive conditions of either the gastro-intestinal mucous membrane or the skin.

2. In those cases in which, because of grave and advancing lesions, rapid mercurialization is absolutely necessary.

3. In those cases characterized by obstinate localized lesions which can be most directly reached by this plan of treatment.

4. Possibly in those cases in which early differentiation between syphilis and malignant disease or tubercular ulceration is extremely important.

5. Possibly when it is important to shorten the period of doubt intervening between the appearance of a chancre and secondary symptoms. Rapid disappearance of an indurated sore in consequence of hypodermic injection might throw light upon the true nature of a suspicious sore without being open to all the objections which attend the systematic and slow administration of mercury by the mouth.

Choice of Preparations.—The soluble salts are to be preferred to the insoluble in the large majority of cases, because of greater exactness in the matter of dosage and because they are less liable to be followed by undue local reaction or general toxic symptoms. They are always to be employed when there is need for rapid mercurialization.

Insoluble salts should be reserved for cases in which frequent visits to the surgeon are impossible and in which no contra-indications exist. The stability and solubility of the bichloride commend it as the salt of choice when soluble salts are employed. Among the insoluble salts calomel and yellow oxide are to be preferred. It should be remembered that the last is somewhat less active, though much less irritating. The gray oil is the most available form of administering metallic mercury.

Contra-indication.—In cases of crippled kidneys, diabetes, profound anæmia, marked atheroma, great debility, or any profound systemic dyscrasia not depending directly upon syphilis, the hypodermic method of treatment is dangerous, and the case, even if urgent, will probably do better under some other treatment.

Vaporization.—This method of introducing mercury into the system has practically been abandoned as a routine practice, since it is more troublesome than other methods, is more difficult to apply privately, and is in the majority of cases not attended by better results. The drug commonly employed is calomel; the average dose is twenty grains.

The apparatus consists of an alcohol lamp placed beneath a metallic saucer, which is supported on a tripod. This apparatus is placed beneath a cane-bottomed chair, upon which the patient is seated naked and with a blanket pinned tightly around his neck and dropping to the floor, enclosing the body and the chair in a tent. Thirty grains of calomel are placed in the metallic dish, the alcohol lamp is lighted, and the blanket is draped around the patient. The lamp is extinguished at the end of twenty minutes, and the patient is allowed to sit for twenty minutes longer in the calomel vapor; he then wraps himself in the same blanket that he has used during the vaporization, and retires to bed for a couple of hours, or for the night if the vaporizations are administered before going to bed. There should be some one present, or at least within call, during these vaporizations, since the heat and the concentrated attention of the patient sometimes produce syncope.

This treatment is indicated when other methods have failed, and particularly in cases of widely diffused small, hard, papular syphilides, or when obstinate or precocious ulcers are present. It is then invaluable.

Local vaporization is sometimes efficacious in the treatment of obstinate plantar or palmar syphilides. The foot or the hand may be kept in a box filled with the vapor of mercury for one or two hours daily.

Mercuric Baths, Thermal Springs, and Heat.—MERCURIC BATHS administered for the purpose of causing absorption of the drug have been little employed, since other methods are more exact and easier of application. The value of such baths, however, in combating by direct action certain wide-spread skin-lesions, and particularly in exerting an antiseptic effect upon pustular and ulcerating eruptions, thus minimizing or altogether preventing the effects of pyogenic infection, is undoubted.

In papular and pustular syphilides, papular and ulcerating gummata, and moist papules, the baths are very serviceable, particularly in cachectic patients who do not well support vigorous treatment by the mouth. Tubercular and gummatous skin affections are also beneficially acted upon by this method of treatment.

When the whole body is not involved in the lesions the partial bath may be employed. Lesions about the genitalia and the rectum may be benefited by a sitz-bath, or in case of plantar or palmar psoriasis or syphilitic onychia the hands or the feet alone may be submerged.

The strength of the bath should be about 1 to 20,000. Finger advises that from two drachms to an ounce of corrosive chloride of mercury should be dissolved in a pint of water and be added to the bath. It should be at a temperature of 78° to 80° F. This temperature should be maintained by the addition of hot water from time to time, the patient remaining in the tub for about two hours daily, immediately after the bath is completed retiring to bed for an hour, or, if it is administered in the evening, retiring for the night.

THERMAL SPRINGS.—In this country, the Hot Springs of Arkansas, abroad, the Baths of Aix, are widely known and extensively patronized for the supposed specific effects of the water upon syphilis. The general opinion of the profession is, however, that the waters of these springs have no special remedial value, and that hot salt baths at the sea-shore, or hot tub-baths at a wholesome mountain resort, would be equally useful to those who derive the most benefit from the springs.

The patients who should be sent to the springs are—

1. Those whose mode of life is unhygienic and who cannot be controlled while under home or other customary influence. This includes patients addicted to excesses, especially in the direction of alcohol and tobacco, and those whose devotion to work is so close and constant as to interfere with their general health. 2. Those whose symptoms resist full doses of the specific drugs or who are unable to take large doses without a break-down of the digestive apparatus or the production of mercurial or iodic intoxication. Under such circumstances, should there be involvement of the viscera or of the brain or spinal cord, the Hot Springs treatment is particularly indicated. 3. Those who with syphilis have intense syphilophobia, and who require the mental impression and in addition the tonic influence of change of scene and climate. 4. Those with defective elimination or with marked idiosyncrasy as regards either mercury or the iodides.

Such patients will derive most benefit from the springs; but it is by no means necessary to send all who would be classed under any of the preceding groups for thermal treatment.

The course of treatment adopted at the springs has for its active principle the administration of the specific drugs; practically no dependence is placed upon the waters as curative agents. Aided by the increased elimination and greater tissue-activity which these waters encourage, larger quantities of mercury and iodide are administered than would be tolerated under ordinary circumstances. The mercury is usually given in the form of inunctions, and, if the symptoms call for it, large doses of the iodides are administered.

Fordyce states that the majority of the patients who come to the Hot Springs use both the hot baths and some form of mercury: hence it is difficult to estimate the relative value of each. Patients who do not take mercury, but depend on bathing or on drinking the water for weeks and months, exhibit no change in the disease which can be attributed to the water. Patients who come to the springs after a long mercurial course at home with the idea of "boiling out" the mercury, of which they suppose their system to be full, sometimes develop ptyalism after a number of baths, thus showing that the waters have an influence in increasing capillary circulation, favoring tissue-change, and causing greater activity in the elimination of matter foreign to the tissues. Persons coming from malarial regions, though they have had no previous outbreak of malaria, after one or two weeks sometimes develop typical fever. Gouty subjects are liable to suffer from outbreaks of this trouble, and malignant tumors are prone to grow with increased activity. It seems reasonable to suppose that the increased tissue-change brought about by the hot baths will be useful in hastening the absorption of the neoplasm of syphilis. Moreover, the general health is often benefited by change of air and scenery.

Whatever be the action of the Hot Springs, it is true that under their influence patients in a profound state of cachexia who have been unsuccessfully treated by competent physicians sometimes improve rapidly, and that some cases of late syphilis are more quickly cured at the springs than at home. This advantage, however, cannot be claimed for the early stages. The use of hot water internally and by bathing undoubtedly increases the activity of the excretory organs, enabling the patient to tolerate the drug in larger quantities. Still, ptyalism and gastro-intestinal irritability frequently occur. It is not asserted that the bath treatment prevents relapses. Lustgarten states that the chief benefit from the Hot Springs is from the hot bath.

Sulphur baths do not differ in reaction from those of ordinary springs. Sodium chloride and iodine brine baths seem, however, to increase oxidation.

The danger incident to bath treatment lies in over-confidence in the healing virtues of the springs, thus leading patients to stop all treatment after the symptoms have disappeared, with the idea that they are permanently cured, and substituting short and heroic treatment for the prolonged course which they require. This is to be unsparingly condemned.

Hot Baths.—The value of hot baths as adjuvants in the specific treatment of syphilis is beyond dispute, and it is well to order as a routine practice during the time that mercury is administered the daily administration of a hot-air or hot-water bath, continued for ten to twenty minutes, and taken either at night on retiring or in the morning, according to the convenience or inclination of the patient. The elimination of mercury is facilitated, larger quantities are tolerated, and in certain cases where without the baths doses of the specific far too small to influence materially the lesions of syphilis produce beginning ptyalism, efficient doses can be given without untoward symptoms.

These baths, if of hot water, should be from 100° to 104° F.; if of air, from 180° to 200° F. In ordering them the question of idiosyncrasy should be fully considered; during their administration the patient should have an attendant at hand, in case syncope be produced.

Heat thus applied to the general surface increases the elimination of the mercury, even in the urine, probably because of the more active tissue-changes excited by the bath. Thus, when hydrargyrism develops, the application of the hot baths affords one of the most active and efficient means of relieving symptoms, since it promptly rids the system of the excess of mercury. The hot-air baths seem to be particularly serviceable, since they occasion free diaphoresis and elimination of the mercury through the sweat-glands; in consequence of the thirst they excite, bland liquids are ingested in large quantities, and these being taken up into the circulation tend to increase metabolism.

Hot-air baths may be administered by placing the patient in bed, covering him with several blankets, which by means of a half hoop or other device are lifted in the form of a tent, and then putting beneath the tent an alcohol lamp. It is better to have a box specially constructed for this purpose; it can be made at an expense of ten or fifteen dollars. In the box is a stool on which the patient sits; the lid is so arranged that when it shuts down the head alone is left exposed. Around the opening left for the neck is packed a bath-towel. An alcohol lamp or gas stove within the box is lighted, the lid and door of the box are closed, and the patient is allowed to sweat for ten to twenty minutes. He then takes a cold shower or sponge bath, and dries himself by vigorous friction with a coarse towel. Unless from idiosyncrasy these baths produce weakness, they should be continued daily through the entire course of treatment.

The general subject of hot baths in the treatment of syphilis has been investigated by Borovski.

His clinical observations were made on twenty-eight syphilitic patients. Heat was employed in the form of (*a*) ordinary hot-water baths at from 98° to 104° F., of thirty minutes' duration; (*b*) artificial sulphur baths (prepared by adding one pound of sulphur to each bath) at from 100° to 104° F., of from twenty to thirty minutes' duration; and (*c*) hot-air baths at from 180° to 200° F., of from fifteen to thirty minutes' duration. His results may be summarized as follows. 1. Both tepid and hot-water baths, as well as those of sulphur and hot air, invariably increase the elimination of mercury in the urine. 2. The elimination proceeds more energetically the higher the temperature to which the patient is exposed. 3. The cause of such intensified excretion of mercury should be sought in an increase of the systemic metabolism, accompanied by the disintegration of mercurial albuminates. 4. A mercurialized patient's organism can be completely freed from mercury by means of the systematic employment of heat in one form or another. 5. In cases of mercurialism, when the elimination of mercury ceases spontaneously, the drug can be made to reappear in the secretions by the use of hot baths. 6. Mercurial stomatitis can be cured by heat more quickly than by any other means. 7. Hot-air baths, while inducing an enormous perspiration, promote the elimination of mercury also through the sweat-glands. The total quantity of sweat excreted during a bath amounts to four hundred cubic centimetres and more; that of mercury in the sweat to 1.6 milligramme and more per four hundred cubic centimetres. Hence, as a means of freeing the patient's system from mercury, they should be preferred to all other baths. 8. The appearance of mercury in the sweat naturally suggests that diaphoretics generally are useful adjuvants in the treatment of mercurialism. 9. Tepid baths (88° F.) should be resorted to only in cases of hydrargyrosis in which higher temperatures are contra-indicated on some grounds. 10. Hot-air baths are borne by patients better than hot-water ones (98° F.), which sometimes give rise to fainting. 11. Hot-air baths at from 170° to 180° F., of twenty minutes' duration, are borne better than those at from 140° to 160° F., of thirty minutes' duration, while the physiological and therapeutical effects of the former are practically identical with those of the latter. 12. In persons having an idiosyncrasy against mercury the employment of heat sometimes affords the possibility of safely continuing mercurial treatment. 13. Hot-air baths, while inducing intense thirst, involve an increased ingestion of fluids, which in its turn leads to an increase in the bodily metabolism. 14. As regards the elimination of mercury from the organism, artificial sulphur baths do not offer any advantages over other baths. 15. The time required for the complete excretion of the metal from the patient's system varies according to the total amount ingested, individual peculiarities of the patient, temperature of the baths, etc. 16. A simultaneous treatment of syphilis by mercury and heat may sometimes effect a cure more quickly than a mercurial treatment alone. 17. The heat treatment alone (one or two baths daily for a fortnight), however, usually proves powerless to bring about a cure. 18. In a patient with a diseased vascular system the use of hot water requires great caution.

THE LOCAL APPLICATION OF HEAT often markedly hastens the disappearance of syphilitic lesions when judicious treatment is employed at the same time. Heat may be applied locally in the form of baths, lasting for one or two hours, or, when these are not practicable, in the form of hot compresses wrung out of hot corrosive chloride solution and covered with a hot-water bag.

Indurations, gummata, periosteal nodes, and obstinate ulcerating syphilides are particularly amenable to the combined action of local heat and general specific treatment.

Kalashnikoff observed on thirty-one patients the effect of heat applied locally to the surface. In cases in which there were widespread syphilides the most affected limb was placed in a hot bath (115° F.) for half an hour twice daily. During the intervals warm compresses were kept wrapped about the parts. Where the lesions were in such portions of the body that baths were impracticable, hot fomentations or the hot-water bag (111° to 122° F.) were applied for an hour twice daily, the treatment during the intervals of application being the same as before. In one group no mercurials were used; in the other, inunctions or injections of mercury, with or without potassium iodide, were employed. Kalashnikoff's conclusions are:

1. Heat, applied locally, powerfully promotes the resolution of syphilides in the region treated.

2. Syphilides of all kinds disappear more rapidly under the influence of heat than under that of a mercurial treatment. The primary indurated sore is resolved in from eight to sixteen days without leaving any sclerosis; roseola in from four to eight days; papules and superficial impetiginous syphilides in from eight to twenty-one days; non-ulcerating tubercles and gummata in from seven to twenty-four days; ulcerating tubercles and gummata become cicatrized in from one to six weeks; periostitis disappears in from one to twenty-four days; osteocopic pains subside in from three to eight days. Commensurate with these local changes, the patient's general condition is markedly improved.

3. By the use of heat and mercury a more rapid absorption is promoted than by the use of either agent alone.

4. In cases of relapse the comparative immunity of parts treated by heat is striking.

5. Heat is especially indicated in obstinate condylomatous lesions which refuse to yield to mercury or iodides.

6. Heat is contra-indicated in patients whose weakness is so great as to render dangerous the necessary mechanical disturbance, and in cases of moist papules, where dusting with calomel will be found more satisfactory.

Electric Baths.—It is asserted that by electric baths there can be brought about active absorption of mercury by the skin and that the dosage can be accurately regulated. The patient is immersed in a solution of sublimate, through which a current of electricity is passed for the purpose of occasioning absorption. The apparatus required is elaborate, and the alleged results are far from proved.

Intravenous Injection of Mercury.—Bacelli has treated syphilis by intravenous injections of corrosive sublimate solution, holding that thus he secures a more exact dosage and a more rapid and powerful effect upon syphilitic lesions than when larger doses of mercury are given in other ways. The solution he employs is thus made:

℞ Hydrarg. chlor. corros., gr. i;
Sodii chlor., gr. iii;
Aquæ destil., f℥ii.
S.—♏xx to ʒi daily, by intravenous injection.

The median basilic or cephalic vein is made prominent by winding a bandage tightly about the middle third of the arm. The skin overlying the vein having been thoroughly cleansed, the needle, which should have a smooth sharp point, is boiled, is attached to the filled syringe, and is driven directly into the vein. The solution is then slowly injected. Absence of pain and of subcutaneous tumefaction shows that the solution is passing directly into the blood-current. In making these injections the syringe and the lumen of the needle must be entirely free from air-bubbles. Renault and Tomassoli report good results from this method.

Its rapid action is said to commend it in certain conditions. Tertiaries yield more readily than secondaries. The papular, macular, and squamous syphilides, condylomata, sore throat, and the chancre all show improvement. But, although the mercury circulates more readily in the blood, it is also eliminated more rapidly. The frequent occurrence of sequelæ is explained, according to Blaschko, by the fact that after intravenous injection no trace of mercury could be found on the fourteenth day, while after inunction traces of the drug are demonstrable for weeks and months.

In rapidly spreading skin and mucous membrane eruptions, and in grave cases of syphilis of the central nervous system, intravenous injections are warmly commended, some eight to twelve being employed to subdue the more threatening symptoms; the cure is completed by one of the usual methods of administering mercury.

The Elimination of Mercury.—The elimination of mercury begins very shortly after the administration of the drug: thus, examination of the urine showed the presence of mercury two hours after hypodermic injection.

Schuster finds that mercury is irregularly eliminated with the urine usually, but regularly and completely with the fæces, and that this elimination after an extensive course of inunction is complete in about six months, thus showing that persistence of mercury in the organism does not occur. The kidneys, the intestinal mucous membrane, and the salivary glands are chiefly active in eliminating mercury from the system.

The Use of Iodides in Syphilis.—The statement that "mercury cures, iodine relieves, syphilis" may through bacteriological research be proved to have a scientific foundation, since the former drug is incontestably superior as a germicide. This may explain its great value in the earlier stages and the comparative inefficiency of iodine during that period. Although this seems to be a well-established fact, there is some diversity of opinion about it, based upon the views which regard iodine (*a*) as a direct specific; (*b*) as a promoter of the eliminative and absorptive processes. If the former view were correct, iodides should be employed oftener and more freely in the secondary stage than is at present the custom. The views of those syphilographers who hold the opposite belief have been summarized by Mauriac, who says that though the action of the iodides may be less rapid than that of mercury, it is deeper and more durable, and is useful in those accidents that are graver, more destructive, and less liable to heal spontaneously; their sphere of action is, therefore, much greater than that of mercury, and their relative harmlessness is a great advantage. According to him, they should be employed—(1) in the phagedenic forms of the initial lesion; (2) in the beginning of the secondary period, especially to combat the fever and headache; (3) in the erosive and ulcerative syphilides; (4) in all the syphiloderms of transition, the papulo-squamous and papulo-tuberculous; (5) in all tubercular and all malignant syphilides; (6) in all subdermic syphilitic manifestations; and (7) in gummata or gummatous exudates that break down and ulcerate.

On the other hand, Sigmund, though he sometimes uses the iodides, in combination with mercurials or alone, in the milder syphilitic manifestations, as erythema and papillary eruptions with general lymphatic involvement, does not think it possible that they can replace the mercurials, and usually reserves them for employment in very marked general lymphadenitis, in scrofulous constitutions, in rheumatoid diathesis and headaches, accompanied or not by loss of sleep, in unfavorable hygienic or dietetic conditions, in diseased conditions of the gums and teeth, and in general in all those conditions in which the idiosyncrasies of the patients or the constitutional complications contra-indicate the use of mercurials.

Finger believes in the combined use of the iodides with the mercurials in the later stages of the syphilitic treatment, when, he thinks, they are superior to the mercurials; but Neumann often uses them in the mild relapses of the secondary stages and in those of the tertiary, reserving the mercurial treatment, in the form of inunctions preferably, for the severer manifestations of both periods. He considers the iodides especially useful in periostitis of the joints, muscles, or synovial sheaths of tendons, and in the tertiary affections of the eyes and internal organs, when he uses mercurial inunctions also.

The value of the iodides is so slight in the ordinary cases of secondary syphilis that it is more than counterbalanced by their irritant effect upon the gastro-intestinal mucous membrane. As a rule, their therapeutic value increases in direct ratio with the age of the syphilis, but even in early syphilis the iodide should be added to the mercurial treatment whenever extensive and dense exudation has occurred, whether in the deeper layers of the derm, in the subcutaneous connective tissue, in the periosteum or bone, or in the viscera.

The routine use of the iodides has been already sufficiently described. The old rule of measuring the required amount by the effect upon the symptoms is a useful one. It may lead to the administration of enormous doses, but if the diagnosis be assured the evil effects of the drug are not to be compared in gravity with those of the disease. Used in this way the practitioner will often be gratified to find the iodides finally causing the disappearance of obstinate osteocopic pains or violent cephalalgias, the resolution of large and threatening gummatous swellings, the subsidence of periosteal nodes, the cicatrization of enormous ulcers, the return of power to paretic or paralyzed muscles, the cessation of epileptiform convulsions, and even the re-establishment of the mental faculties after they have been persistently and to all appearances hopelessly disordered.

There is nothing more satisfactory in therapeutics than the direct and unmistakable benefits following the administration of the iodides in such cases.

In doubtful cases, for diagnostic purposes, large and increasing doses may also be given, sometimes with the result of promptly revealing the specific character of the lesion requiring treatment. It must be remembered, however, that other obscure conditions than those resulting from syphilis may be benefited by full doses of the iodides, and a faulty diagnosis and prognosis may be the outcome of a too implicit dependence on the "therapeutic test." Still more dangerous would be the acceptance of the rule formulated by Jullien and H. C. Wood. The former asserts that "the existence of syphilis contributes powerfully towards producing tolerance of the iodides. Experience proves, in fact, that in persons free from this poison the toxic phenomena of iodism are much more to be dreaded. In the same manner an antidote may be dangerous, or even fatal, when the organism is not under the influence of the poison which it is intended to combat." The latter says, "In all cases of doubtful diagnosis the so-called therapeutic test should be employed; and if sixty grains of potassium iodide per day fail to produce iodism, for all practical purposes the person may be considered to be a syphilitic."

These statements, if well founded, would convey an important practical lesson of the greatest value in the diagnosis of obscure conditions suspected to be of syphilitic origin. If unfounded, they may be seriously misleading.

A few years ago this subject was discussed at length, and subsequently the opinions of twelve of the leading syphilographers and neurologists of this country were obtained by one of the writers. They without exception held the view that no such rule of diagnosis could be formulated.

Several formulæ have already been given for the administration of iodides. A saturated solution (potassium iodide, ʒv; water, q. s. ad ℥i) is the most convenient form in which to administer the drug when it is given in ascending doses. In addition to this preparation the patient may be ordered compound syrup of sarsaparilla, to a tablespoonful of which the required dose of iodide can be added, the patient immediately afterwards taking one or two glasses of water or milk. Free dilution is essential in avoiding gastric irritation.

Rubidium iodide has been warmly recommended, on the ground that it is less disagreeable than potassium iodide, is less liable to disturb the stomach, and is not so apt to produce acne or other symptoms of iodism, while it is almost equally potent in causing absorption of syphilitic infiltrates. Iron iodide is also a valuable preparation, particularly when syphilitic anæmia is marked. This may be given either in pill form or as a syrup. Lithium iodide, warmly commended because of the large quantity of iodine it contains (over ninety-five per cent.), has proved too irritating for use.

Vegetable infusions and decoctions are sometimes useful as adjuvants in the treatment of syphilis, but have no specific action of their own. The two best recognized are the following:

Succus alterans. (McDade's formula.)

℞ Ext. smilacis sarsaparillæ fl.,
Ext. stillingiæ sylvat. fl.,
Ext. kappæ minoris fl.,
Ext. phytolaccæ decand. fl., āā f℥ii;
Tinct. xanthoxyli carolin., f℥i.

M. S.—Take a teaspoonful in water three times a day before meals, and gradually increase to tablespoonful doses.

This may be employed in alternation with the mixed treatment where daily dosing of the latter cannot be borne. Taylor suggests as a tonic mixture:

℞ Ext. erythrox. cocæ fl., f℥ii;
Tinct. gentian. comp.,
Tinct. cinchon. comp., āā f℥i;
Elix. calisayæ, f℥iv.

M. S.—One tablespoonful in a wineglassful of water three times a day, one hour after meals.

When the appetite, digestion, or nutrition needs attention, neither of these preparations seems to be as efficient as the following:

℞ Strychninæ sulphat., gr. i;
Acid. phosphoric. dil., fʒiii;
Liq. pepsinæ, q. s. ad f℥vi.

M. S.—One teaspoonful in water after each meal and before going to bed.

Serum Treatment.—The commonly accepted theory of the day in regard to immunity seems to rest on the fact that micro-organisms produce not only substances which act injuriously upon the system of their host, but also certain products which are toxic to themselves, and which are able to render the soil in which they grow immune against new infection by the same microbe. The immunizing substance is found in the blood and tissues, but in some instances, at least, is excreted by the kidneys.

In the clinical history of syphilis there are found strong reasons for believing that a similar substance may be carried either to the child through the mother's blood, or to the mother from the child infected by the father.

Profeta showed that an apparently healthy child born of a syphilitic mother could not acquire syphilis from the lesions of the mother. Colles and Baumès observed, *vice versa*, that a syphilitic child born of an apparently sound mother could not convey the disease to her.

Bonaduce holds that, particularly in syphilis, and consequently in other bacterial diseases, immunity by filtration of protective serum through the placenta would result far more frequently than is the case were it not that through hemorrhages or traumatisms the indirect communication between the maternal and fœtal blood is made direct, and not only the immunizing substance, but the active living micro-organisms, are carried from the diseased to the healthy human being, and thus, in place of protection against syphilis, syphilis itself is implanted.

When the virus of syphilis has once entered the fœtus it finds every condition favorable to its development, and it is prone to manifest itself in a severe form. In consequence there is a large production of the immunizing substance which is filtered through the placenta.

The difficulty in the practical application of these facts lies in determining the exact period at which this antitoxin is found most abundantly in the circulation. Moreover, the serum of the infected organism contains, in addition to immunizing substances, certain poisonous compounds which act injuriously upon the tissues, lessening the resistance, and thus encouraging proliferation of micro-organisms. Bonaduce holds that if it were possible to accomplish artificially what nature does in the case of the mother,—that is, to immunize against syphilis, in accordance with Colles's law,—the Gordian knot of syphilitic therapeutics would be cut. Since the kidneys are functionless in intra-uterine life, and since the micro-organisms of syphilis exhibit special virulence when they attack the fœtus, there should be in the circulation of the child at birth both immunizing substances and toxic products in unusual concentration.

To separate these from each other heat may be employed, since it is well known that the toxins are destroyed, while the antitoxins remain intact. Gamaleia, Arnaud, and others have shown this in the case of other microbes.

On the basis of these considerations Bonaduce has conducted a clinical study. Blood was drawn from three children born with all the characteristics of hereditary syphilis. This was allowed to stand for a day on ice, and from it thirty-five cubic centimetres of serum were obtained, to which one hundred cubic centimetres of sterilized water were added. This mixture was heated for ten minutes to 100° C., and was filtered.

A patient who received twelve injections (each ten cubic centimetres every other day) of this serum recovered without other treatment; but Lane holds that the treatment does not appear to modify the course of the disease or to diminish the intensity of subsequent manifestations.

Blood may be used from the placenta of a syphilitic child, or may be taken from individuals who are at the height of secondary syphilis, but in all cases the serum should be employed with the most minute antiseptic and aseptic precautions.

In Italy, Tommasoli some time since proposed a method of hæmotherapeutics in the treatment of syphilis. This consists in the injection of serum derived from the blood of lambs or calves, the practice being based on the theory that since these animals are immune to the disease, their body fluids must contain some immunizing substance.

Fournier has obtained some results from injections of the blood-serum of the dog and horse, and Pellizzari has expressed the hope that by the injection of the blood-serum of syphilitics who are in the transitional period between the secondary and tertiary stages of development all secondary lesions may be prevented in those who are suffering from chancre.

The idea of the treatment of syphilis by injections with blood from animals naturally immune, or by injections of serum free of syphilitic toxic properties but supposed to contain the antitoxin of syphilis, introduces an absolutely novel feature in the therapeutics of syphilis. Already numbers of successful cases have been reported.

Experience has shown, however, that little confidence can be placed in these. The case contributed by Bonaduce is not conclusive, since the diagnosis was by no means established in the first instance.

Gilbert and Fournier obtained from the blood of two patients in the tertiary stages of syphilis—one suffering from tabes, the other from gummata—sufficient serum to carry out the antitoxin treatment in one case. The subject experimented on was a patient who had received no specific treatment. He was suffering from infecting chancres of the penis, characteristic inguinal enlargements, marked anæmia, nocturnal headache, joint pains, and a diffuse maculo-papular eruption. He was given injections of the serum at irregular intervals through twenty days. About an ounce was used for each injection. In all he received about ten ounces of the serum. As a result of this treatment all symptoms disappeared, with the exception of a slight roseola.

Encouraged by success in this case, Gilbert and Fournier employed a new method. They inserted under the skin of dogs and goats blood-serum, chancres, and excised skin eruptions taken from patients in the primary and secondary periods of the disease, hoping thus to increase the natural immunizing powers of the blood of the animals treated. Seventeen patients were treated with the serum obtained from these animals. The results were contradictory.

Cotterell treated eighteen cases by the injection of blood-serum of patients who had suffered an attack of syphilis. The details of the method are not given, but the author noted improvement.

Zittmann's treatment of intractable syphilis has for its underlying principle, elimination by diaphoresis and purgation.

The evening before the treatment is begun, the patient receives two pills, each containing two grains of calomel, five grains of compound extract of colocynth, and two grains of extract of hyoscyamus. The remainder of the treatment consists in the use of two decoctions. The first contains sarsaparilla root four ounces, anise- and fennel-seed each five hundred grains, senna leaves one ounce, and liquorice root four ounces; these are bruised and added to four gallons of water, together with eighty grains each of white sugar, alum sulphate, and calomel, and twenty grains of the red sulphide of mercury enclosed in a linen bag; the water is then boiled down gently to one gallon. This is decanted and constitutes Decoction No. 1. Its dregs are put into three gallons of water, with two ounces of sarsaparilla root, and one ounce each of lemon-peel, cardamom seed and liquorice root, and boiled down to one gallon. This constitutes Decoction No. 2.

The morning after taking the purgative pills and each day after this, the patient drinks half a pint of hot decoction No. 1 at nine, ten, eleven, and twelve o'clock, and in the evening half a pint of cold decoction No. 2 at three, four, five, and six o'clock. He is kept in bed except for one hour each evening. On the fifth day he takes a hot bath and is allowed to dress. On the evening of the fifth day two of the above pills are again administered, and the next day the routine treatment is resumed. The whole course lasts fifteen days.

LOCAL TREATMENT OF SYPHILIS.

THE CHANCRE.—This lesion should be treated on general surgical principles; the surface of the ulceration should be kept clean by means of antiseptic sprays or washes, to avoid mixed infection. Such applications are valueless for the purpose of aborting constitutional disease, but are serviceable in hastening cicatrization of the local lesion. The following prescriptions are useful:

℞ Hydrarg. chlor. corros., gr. $\frac{1}{10}$;
Zinci sulpho-carbolat., ℈i;
Ext. opii aq., gr. xii;
Aquæ ros., f℥iv.

M. S.—Apply by means of a pledget of cotton. Change every two hours. Dilute if painful.

℞ Acid. boric., ℈ii;
Tinct. opii, f℥ii;
Liq. plumbi subacetat. dil., f℥ii.
M. S.—Apply locally.

℞ Zinci chloridi, gr. v;
Tinct. opii, f℥i;
Aquæ ros., f℥iii.
M. S.—Apply locally.

When there is a tendency to form crusts, salves are useful:

℞ Emplast. hydrarg.,
Cerat. resin., āā ℥ss.
M. S.—Use locally.

℞ Iodoform., ʒii;
Bals. Peruv., ʒi;
Unguent. petrolat., q. s. ad ℥i.
M. S.—Use locally.

If the granulations are sluggish, daily touching with a five per cent. silver nitrate solution is desirable.

When the chancre is covered by a tough pseudo-membrane, beneath which ulceration is extending, probably from the reaction of the ordinary pus-microbes, destructive cauterization may be necessary. Nitric acid or acid mercuric nitrate may be employed, the surrounding tissues being protected by oiled cotton; antiseptic fomentations should follow.

Gangrenous and phagedenic chancres require the same local applications, supplemented by tonic and supportive treatment.

Of the dry powders, iodoform is the most serviceable. It may be administered pure or mixed with powdered boric acid or starch, or may be applied as a ten per cent. ethereal spray. Calomel mixed with an equal quantity of lycopodium is a satisfactory local remedy. Dermatol is an astringent, healing antiseptic, free from irritating properties and devoid of unpleasant odor. It may be used either as a powder or as an ointment. Aristol is also serviceable. The dry powder is inert, hence it should be dusted on the surface of the lesion and a drop of olive oil allowed to fall on it from a glass rod; it should then be covered immediately with some thin, impermeable substance, under which solution takes place slowly. No cotton or charpie should be applied to the ulcer. The dressing should be renewed twice daily.

To chancres not covered by crusts or pseudo-membrane and exhibiting but slight inflammatory reaction, flexible collodion containing one-tenth part of iodoform or one-hundredth part of sublimate may be applied.

To urethral and rectal chancres iodoform in the shape of suppositories may be applied after copious flushing with dilute corrosive chloride solution (1 to 10,000). These suppositories, made of cacao butter or gelatin and of appropriate shape and size, should contain from two to five grains of iodoform. Gray ointment diluted with three parts of vaseline is also serviceable in the local treatment of these lesions.

Chancres of the tongue, mouth, or tonsils are treated by frequent gargling with corrosive chloride solution (1 to 6000) and local application of silver nitrate solution (1 to 10), sublimate solution (1 to 20), or iodoform collodion (1 to 10).

THE SYPHILIDES.—Skin lesions may be benefited by applications of mercury to the surface and the systematic employment of hot baths.

Erythematous syphilides usually require no local applications. When they are sufficiently persistent and conspicuous to demand treatment, the following formulæ will be found useful:

℞ Hydrarg. chlorid. mit., ʒi;
Unguent. zinci oxidi,
Unguent. petrolei carbolat., āā ℥ss.
M. et ft. ung. S.—Apply locally.

℞ Hydrarg. chlorid. mit.,
Pulv. amyli, āā ℥i.
M. S.—Dust lightly over the parts affected.

Papular syphilides are often obstinate, and are especially benefited by (1) vapor baths; (2) inunction and massage; (3) ointments containing mercury in one of the following formulæ:

℞ Ung. hydrarg. nitrat.,
Ung. petrolei carbolat., āā ℥ss.

℞ Hydrarg. ammoniat., ℈i;
Unguent. aquæ ros., ℥i.

These ointments are especially serviceable in the papulo-squamous eruptions. When these attack the hand, a region in which they are persistently recurrent, the local vapor bath proposed by Wells is particularly efficacious. The interior of an inverted hat-box is filled with calomel vapor by means of a small alcohol lamp placed beneath a metal dish containing calomel, and the hand is introduced within the box through a hole cut in the side.

Mucous Patches.—These, for the most part, may be prevented from appearing in the mouth by taking the precautions already mentioned (p. 1010). When they appear, they should be painted two or three times daily with a one to ten per cent. solution of silver nitrate, or touched with the solid stick, and an antiseptic mouthwash should be used, such as the following:

℞ Acid. boric.,
Acid. tannic., āā ℈ii;
Mel. ros., f℥ii;
Aquæ, f℥vi.
M. S.—Use as a mouth-wash.

Or sprays of listerine, Dobell's solution, or hydrogen peroxide may be employed.

Sometimes a sublimate wash is useful:

℞ Hydrarg. bichlorid., gr. i;
Mel. ros., f℥ii;
Aquæ, f℥vi.
M. S.—Use as a mouth-wash.

Iodine, applied to the lesions, is stimulating and resolvent:

℞ Iodi,
Potassii iodidi, āā ʒii;
Glycerini, q. s. ad f℥i.
M. S.—Apply locally.

The scaly patches should be touched every second or third day with ten per cent. chromic acid solution or acid mercuric nitrate half strength. If they still persist, they should be removed by the sharp curette or the actual cautery.

Ulcerated patches in the throat are benefited by the same treatment, the lotions being used as a gargle. Antiseptic sprays are particularly serviceable. In addition, fumigations may be administered, as advised by Mauriac:

℞ Cinnabar., gr. xv;
Hydrarg. iodidi vir., gr. viiss.
M. S.—For one fumigation, lasting twenty-five minutes.

℞ Hydrarg. iodidi vir., ʒss;
Carb. lig., ℥iss;
Benzoin., gr. viiss;
Aquæ, q. s.
M. et ft. trochisci no. xx.
S.—One to be burned morning and night, and the vapor inhaled.

The use of tobacco must be given up entirely, and the mouth kept scrupulously clean.

Condylomata, if vegetating and exuberant, should be cauterized with nitric acid, acid mercuric nitrate, or chromic acid. These last two drugs may produce toxic symptoms. Indeed, death has resulted from the topical application of the latter: hence it should not be applied to a large surface.

℞ Acid. chromic., ʒii;
Aquæ, f℥iii.
M. S.—Apply locally, to a limited area.

The vegetations may also be destroyed by the use of the following mixture:

℞ Plumbi oxidi, gr. iv;
Liq. potass. caust. (33 per cent.), ♏cxvi.
M. S.—Caustic. For external use only.

A single application is usually efficient; sometimes two or three applications are required at intervals of two or three days. After this caustic is applied, the affected surface is dusted with iodoform. A cicatrix forms in from three to ten days.

Bumstead and Taylor commend the following mixture, painted on after careful drying:

℞ Acidi salicylici,
Ext. cannabis indicæ, āā gr. xxx;
Collodion. (flexilis), ℥i. M.

Mild cases require no local treatment beyond cleanliness, drying, and dusting with calomel.

When the papillary overgrowth is extensive, it should be removed by the knife, the resulting raw surface being closed by skin transplantation if necessary.

Pustular and Pustulo-Crustaceous Syphilides.—It is particularly in this class of cases that the mercury and vapor baths are serviceable, supplemented by the calomel and zinc ointment. (See p. 1049.) The latter may be used on the face at bedtime. When the ulcerations are indurated and crusted the following prescriptions may be used:

℞ Hydrarg. bichlorid., gr. ii;
Unguent. hydrarg. nitratis,
Ung. petrolei carbolat., āā ℥ss.

℞ Hydrargyri oxidi rub., ʒii;
Unguent. zinci oxidi, ʒvi.

Leg ulcers should be cleansed, strapped, and bandaged. If they refuse to heal under this treatment, the whole surface and the surrounding skin may be covered in with a piece of thinly spread plaster containing equal parts of emplastrum hydrargyri and emplastrum cerati; over this is applied a tight bandage which includes the foot and leg. Dressings should be repeated in accordance with the amount of discharge.

Tubercular Syphilides, Gummata, and Periosteal Nodes, when non-ulcerated, may best be treated locally by the continuous application over their surface of the following ointment spread on a piece of lint:

℞ Ung. iodi comp., ʒi;
Ung. belladonnæ, ʒii;
Ung. hydrarg., ʒiii;
Ung. petrolei carbolat., ʒiv.

This ointment may be combined with the local use of heat, a hot-water bag being applied to the lesion for as many hours a day as is practicable.

Chronic persistently spreading serpiginous ulceration should be treated by the prolonged bath,—days or weeks if necessary. If this fails the actual cautery is indicated.

Ulcerations are curetted, cleansed, and treated on general principles. Carious and necrosed bones should be subjected to appropriate surgical measures.

In a few reported cases obstinate ulcerating syphilitic lesions which resisted specific treatment recovered promptly after an attack of erysipelas. There has been no formal effort, however, to utilize this fact in the treatment of such lesions.

THE TREATMENT OF HEREDITARY SYPHILIS.

The treatment of inherited syphilis may be considered under the following heads:

1. The prophylactic treatment of the parents before conception;
2. The treatment of the mother during pregnancy;
3. The treatment directed to the child.

1. THE PROPHYLACTIC TREATMENT before conception is that already described as appropriate to syphilis, except that more attention is paid to the general hygiene applicable to the sexual relations, and every effort is made to suppress by full doses of mercury any manifestation of active syphilis.

Probably the most important point in prophylaxis, as far as the practitioner is concerned, is his advice in regard to marriage, or, if this has already been consummated, in regard to preventing conception from taking place.

The doctrine that it is proper to permit a syphilitic patient to marry two and a half years after infection is dangerous. Though it is true that a large proportion of patients who marry within these limits have healthy children, there is a minority who transmit the disease and who infect their wives. *The earliest period at which marriage should take place with the consent of the physician is four years*, and the responsibility of contracting such relations at an earlier period than this should remain solely with the patient.

If syphilis is acquired after marriage, four years at least should be allowed to elapse before conception is permitted.

When, in spite of due warning, or perhaps from lack of it, marriage has taken place and the sexual relations are established, active treatment of the diseased partner is imperative.

2. THE TREATMENT OF THE MOTHER.—Whether the mother is previously syphilitic, or has conceived by a syphilitic husband, or has contracted the disease after impregnation, she is treated in accordance with the principles already laid down. Mercury is pushed to its full physiological limit, and is advantageously combined with moderate doses of potassium iodide. Special care must be taken not to allow the medication to produce gastro-intestinal irritation, since this strongly predisposes to the production of abortion. When the mother is thus treated she will probably bear a living child, and one either healthy or exhibiting syphilis in a mild form.

3. THE TREATMENT OF THE CHILD AFTER BIRTH.—Since the pathology, stages, and general course of hereditary syphilis are similar to those of the acquired disease, treatment is conducted on the plan already described.

In hereditary syphilis the treatment is modified somewhat by the following considerations:

1. There is always a more or less profound cachexia influencing all the nutritive and formative processes, and in itself, aside from specific lesions of vital organs, threatening life.

2. During the secondary period lesions corresponding to the tertiary type, particularly gummata, are frequent.

The cachexia and its results are combated by supplementing the specific treatment by one which is stimulating and supporting. Special attention should be paid to the nutrition. The nurse of the child should, of course, be its mother, since it cannot convey the disease to her. If the child cannot be fed at the breast, its chances for survival are greatly reduced. The selection of the most nutritious and easily digested artificial food then becomes a matter of cardinal importance. Tonic treatment should be employed, iron iodide, cod-liver oil, and preparations of the hypophosphites being most useful.

The iodides are given in conjunction with mercury because of the frequent early appearance of tertiary lesions.

Routine Treatment of Hereditary Syphilis.—The children of syphilitic parents may exhibit characteristic lesions at birth; they may remain apparently healthy for several weeks and then suffer from typical secondaries; or they may remain free from signs or symptoms of syphilis through life.

When a child shows characteristic manifestations of the disease at birth, immediate treatment is indicated.

When an apparently healthy child is born of syphilitic parents, the indications are not so clear, since there is no certainty that the disease will ever develop. As a rule, it is safe to wait for characteristic symptoms when the parental syphilis is paternal, or is old, or when during the whole course of gestation the mother has received vigorous specific treatment. When parental syphilis is maternal, is recent, and particularly when it has not received appropriate treatment, the child should be given the specifics without waiting for symptoms.

In doubtful cases treatment should be delayed till the appearance of constitutional symptoms. The first of these is alteration in the blood: hence repeated comparative studies should be made of this fluid, and should there be an otherwise inexplicable diminution of hæmoglobin and increase of white corpuscles, the diagnosis of syphilis should be considered as established, certainly so far as to constitute an indication for treatment.

The routine method of treatment is as follows. The surface of the child's abdomen is bathed with Castile soap and water, then with a saturated solution of boric acid, after which it is thoroughly dried. Mercurial ointment diluted with three parts of vaseline is then spread on the child's binder, and the latter is applied as usual in infants. Half a drachm of this dilute ointment may be used daily. After the binder has been worn for twenty-four hours the abdomen is again washed with soap and water, followed by boric acid solution; a half-drachm of the ointment is then rubbed into the skin, and the binder previously employed is again applied. This binder is changed for a fresh one every fourth day.

Should the prolonged application of the ointment produce dermatitis, the inflamed skin may be bathed with witchhazel and dusted with zinc stearate, carbolized talc, or other healing powder, the mercury then being administered in the form of inunctions, which are rubbed into the back, sides, and front of the chest, and the arms, thighs, and legs, a fresh skin surface being chosen each day.

Exceptionally, mercurial ointment, even though used in this way, occasions so much local reaction that its surface application must be abandoned.

When treatment by the mouth must be resorted to, probably the most efficient formula is the following:

℞ Hydrarg. cum creta, gr. i–vi;
Sacch. alb., gr. xii.
M. et div. in chart. no. xii.
S.—One powder three times a day; to be taken soon after nursing.

Bumstead and Taylor have used in many cases:

℞ Hydrarg. biniodidi, gr. i;
Potassii iodid., ʒiv;
Syr. sarsaparillæ comp.,
Aquæ, āā f℥ii. M.

Of this mixture a child one month old may take five drops thrice daily, increasing the dose by a drop every five days. To a patient over five years of age one-half teaspoonful may be given, the dose being gradually increased to one or one and a half teaspoonfuls.

Externally, at the same time, a mild mercurial ointment may be used, or, better, the following may be kept in contact with the skin under pressure:

℞ Ung. hydrarg.,
Ung. zinci oxidi, āā ℥ss;
Bals. Peruv., ʒi. M.

In conjunction with inunctions or the internal use of the powders of mercury with chalk, potassium iodide may be given in a syrupy solution, in doses varying from half a grain to a grain, or, if there be any marked tertiary symptoms, even in much larger doses, three or four times daily.

Occasionally nothing whatever will be retained by the stomach. Under such circumstances hypodermic injections are indicated. These injections are open to the same objections as obtain against this method in the adult. They are, however, often to be preferred to internal treatment, and should be administered in the manner already described.

The solution of choice is the one per cent. sublimate mixture. (See page 1029.) Beginning with a dose of one minim (one-hundredth of a grain) every second day, the quantity injected is gradually increased to two, three, or four minims.

The treatment, in no matter what form, should be kept up long after the disappearance of syphilitic symptoms, and it is well to continue the mixed treatment till after puberty. In addition to the medicinal treatment, special attention should be paid to cleanliness and hygiene. If possible, the life should be out of doors, and the food should be healthy and invigorating.

The indirect treatment of the child—*i.e.*, the administration of specific medicine to the nursing mother—is of possible utility when other methods have failed or must be temporarily interrupted.

INDEX.

- ABSCESS OF
  - Bartholin's gland, 174
    - treatment, 174
  - Cowper's gland, 272
  - Fallopian tubes, 176
  - groin, 47
    - chancroidal, 48
    - gonorrhœal, 187
  - kidney, 577
    - (see Kidney)
  - ovaries, 176
  - perinephric region, 579
    - diagnosis, 584
    - etiology, 580
    - prognosis, 586
    - symptoms, 581
    - treatment, 586
  - periurethral, 188
  - prevesical, 426
  - prostatic
    - gonorrhœal, 190
    - tubercular, 733
  - seminal vesicles, 714
    - (see Seminal vesiculitis)
  - suprarenal capsules, 613
- ADDISON'S DISEASE, 614
- ADENITIS
  - (see Lymphadenitis)
- ADRENAL BODIES, 613
  - suppuration of, 613
    - treatment of, 613
  - tumors of, 614
- ALBUMINOSURIA, 344
  - tests for, 363
- ALBUMINURIA, 342
  - causes of, 342
  - differential diagnosis between renal and subrenal, 344
  - pyuria as a cause of, 354
  - tests for, 362
- ANATOMY, SURGICAL, OF
  - bladder, 387
  - ejaculatory ducts, 619
  - epididymis, 618
  - kidneys, 524
  - penis, 1
  - perineum, 465
  - prostate, 6
  - scrotum, 615
  - seminal vesicles, 619
  - spermatic cord, 620
  - testes, 617
  - ureters, 504
- ANATOMY, SURGICAL, OF—Continued
  - urethra, 68
  - vas deferens, 618
- ANURIA, 353
  - (see Urine, suppression of), 293
- ANUS AND RECTUM
  - gonorrhœa of, 193
  - syphilis of, 901
    - diagnosis of, 903
    - prognosis of, 902
    - symptoms of, 902
    - treatment of, 903

- BACTERIURIA, 350
  - (see Pyuria), 352
- BALANITIS AND BALANOPOSTHITIS, 30
  - causes of, 30
  - consequences of, 31
  - diagnosis of, 32
  - symptoms of, 31
  - treatment of, 32
- BARTHOLINITIS, 174
  - treatment of, 174
- BLADDER
  - abscess, prevesical, 426
  - anatomy of, 387
  - atony of, 399
  - atrophy of, 399
  - calculus of, 440
    - diagnosis of, 445
      - bimanual examination, technique of, 445
      - cystoscopy in, 374
      - intravesical exploration, technique of, 445
    - etiology of, 442
    - prognosis of, 449
    - prophylaxis of, 450
    - symptoms of, 443
    - treatment of, 450
      - litholapaxy, 452
        - after-treatment of, 456
        - children, in, 459
          - complications, 463
          - contraindications, 462
          - indications, 461
          - sequelæ, 464
        - Chismore's method, 456
        - perineal method, 457
          - advantages, 458
          - indications, 458
          - technique of, 458
        - preparation for, 451

- **Bladder**, calculus of, treatment of—Continued
    - lithotomy, 464
      - perineal, 465
        - anatomical relations in, 465
        - bilateral, 472
        - indications for, 473
        - lateral, 465
        - median, 471
        - mediolateral, 473
        - sequelæ of, 473
      - suprapubic, 473
        - after-treatment of, 477
        - closure of bladder in, 477
        - complications, 481
        - drainage after, 479
        - preparation for, 473
        - technique of, 474
          - Senn's method of, 475
      - women, in, 482
  - cancer of, 488
    - diagnosis of, 490
    - prognosis of, 491
    - symptoms of, 489
    - treatment of, 491
  - contusion of, 405
    - diagnosis of, 405
    - symptoms of, 405
    - treatment of, 405
  - cysts of, 500
    - dermoid, 501
    - epithelial, 500
    - hydatid, 502
    - inclusion, 502
    - intravesical ureteral, 503
    - urachus, 502
  - diverticulæ, 374
  - exstrophy of, 392
    - diagnosis of, 393
    - prognosis of, 394
    - treatment of, 394
      - operations in, 395
      - treatment before and after, 397
  - fistulæ, 437
    - cystoscopic examination in, 377
    - diagnosis of, 438
    - symptoms of, 437
    - treatment of, 438
  - foreign bodies in, 483
    - diagnosis of, 484
    - symptoms of, 483
    - treatment of, 484
  - hernia of, 399
    - symptoms of, 401
    - treatment of, 401
  - hypertrophy of, 397
    - causes of, 398
    - diagnosis of, 398
    - treatment of, 399
  - inflammation of, 412
    - (see Cystitis)
  - injuries and wounds of, 401
  - innervation of, 389
  - loculate bladder, 376
  - multiple, 392

- **Bladder**—Continued
  - myoma of, 487
  - myxoma of, 487
  - papilloma of, 486
    - (see Bladder, tumors of), 490
  - paresis of, 300
  - patent urachus, 397
  - peritoneal coverings of, 388
  - pouches of, 374
  - quilting of, 373
  - rupture of, 406
    - causes of, 406
    - diagnosis of, 408
    - prognosis of, 409
    - symptoms of, 407
    - treatment of, 410
  - sarcoma of, 487
  - space of Retzius, 427
    - anatomy of, 427
    - inflammation of, 427
    - tumors of, 502
  - structure of, 389
  - syphilis of, 436, 960
  - tuberculosis of, 428
    - diagnosis of, 432
      - cystoscopy in, 373–375
    - etiology of, 429
    - pathology of, 430
    - prognosis of, 433
    - symptoms of, 431
    - treatment of, 433
  - tumors of, 485
    - carcinoma of, 488
    - cystic, 500
      - (see Cysts of)
    - diagnosis of, 490
    - fibroma of, 487
    - myoma of, 487
    - myxoma of, 487
    - papilloma of, 486
    - paravesical, 502
    - prognosis of, 491
    - sarcoma of, 487
    - symptoms of, 489
    - treatment of, 491
      - operative, 492
      - palliative, 491
      - radical, 492
        - excision
          - perineal, 492
          - suprapubic, 493
        - extirpation, 498
          - ureteral implantation, 498
        - resection, 495
  - varicose veins of, 501
  - vascularization of, 398
  - wounds of, 402
    - complications of, 403
    - definition of, 402
    - diagnosis of, 403
    - etiology of, 402
    - prognosis of, 404
    - symptoms of, 402
    - treatment of, 404

Bougies, 229
  à boule, 220
  filiform, 228
    selection and use of, 229
  flexible, 229
Bubo
  chancroidal, 47
  gonorrhœal, 187
  syphilitic, 847

Calculus
  renal, 550
    (see Bladder ; see Kidney)
  ureteral, 515
    (see Ureter)
  urethral, 99
    (see Urethra)
  vesical, 440
    (see Bladder)
Cancer or carcinoma of
  bladder, 448
  Cowper's gland, 273
  kidney, 604
  penis, 64
    diagnosis of, 65
    etiology of, 65
    prognosis of, 66
    symptoms of, 64
    treatment of, 66
  prostate, 775
    diagnosis of, 776
    treatment of, 776
  seminal vesicles, 719
  testicle, 665
    diagnosis of, 666
    prognosis of, 668
    symptoms of, 666
    treatment of, 668
  urethra, 107
    diagnosis of, 107
    symptoms of, 107
    treatment of, 108
Castration, 675
  indications for, 675
  technique of, 676
Chancre
  clinical pathology of, 824
  concealed, 837
  contagion of, 820
  development of, 824
  etiology of, 820
  extragenital, of
    anus, 843
    breast, 843
    cervix uteri, 837
    ear, 928
    extremities, 844
    eye, 923
    face, 838
    head, 838
    lip, 840
    nipple, 843
    tongue, 841
    tonsils and fauces, 842
Chancre, extragenital—Continued
    urethra, 838
      diagnosis of, 110
    vaccination, 845
  genital, 827
    complications of, 829
    coronary sulcus, 827
    meatus, 838
    penis, 827
    prepuce, 828
    subpreputial, 836
    urethral, 838
  incubation of, 824
  induration of, 825
  lymphatic involvement from, 846
  prognosis of, 845
  pseudo-, 820
  relapsing, 819–833
  synonyms for, 825
  treatment of
    destruction or excision, 1005
    local, 1047
Chancroid
  atypical, 42
  auto-inoculation of, 36
  bacillus of, 37
  classification of, 41
  clinical aspects of, 40
  complications of, 44
  diagnosis of, 42
    differential, 43
      from chancre and herpes, 834
  ecthymatous, 41
  elevated ulcer of, 41
  extragenital, 39
    frequency of, 39
  exulcerating, 41
  follicular, 41
  frequency of, 39
  gangrenous, 41–46
  genital, 39
  incubation of, 40
  induration of, 42
  inflamed, 41
  inflamed pustular, 40
  inoculability of, 38
  inoculation of, 36
    technique of, 40
  localization of, 39
  mixed infection in, 43
  multiplicity of, 40
  pathology of, 39
  perigenital, 39
  phagedenic, 41–46
  serpiginous, 41
  subpreputial, diagnosis of, 45
  symptoms of, 41
  treatment of, 50
    of complications
      gangrene, 56
      lymphatic involvement, 57
      paraphimosis, 55
      phagedena, 56
      phimosis, 54
      serpiginous, 56

Circumcision
  complications of, 13
  indications for, 9
  technique of, 9–10
Conjunctivitis
  gonorrhœal, 194
    diagnosis of, 198
    etiology of, 194
    prognosis of, 196
    symptoms of, 194
    treatment of, 196
  syphilitic, 923
Cowperitis, 271
  diagnosis of, 272
  etiology of, 272
  symptoms of, 271
  treatment of, 272
Cowper's gland
  anatomy of, 271
  cancer of, 273
  cysts of, 273
  inflammation of, 271
Cystitis, 412
  classification, 412
    gangrenous, 416
    interstitial, 415
    membranous, 415
      superficial, 415
  diagnosis, 418
    cystoscopic, 374
  etiology, 412
  gonorrhœal, 192
  pathology of, 414
  prognosis of, 418
  symptoms of, 416
  syphilitic, 436, 960
  treatment of, 420
    curative, 421
    prophylactic, 420
  tuberculous, 428
    (see Tuberculosis of bladder), 428
Cystoscope, 367
Cystoscopic diagnosis of
  bladder, normal, 372
  calculi, 374
    diverticulæ, 374
  cystitis, 374
    tubercular, 373
  diseases of upper urinary tract, 376
  fistulæ, 376
  folds, 377
  loculate bladder, 376
  papilloma, 373
  quilting, 373
  submucous hemorrhage, 373
  tuberculosis, 373
  tumors, 377
  ulceration, 374
    simple solitary, 375
    syphilitic, 376
    thrombotic, 376
    traumatic, 375
    trophic, 376
    tubercular, 375
Cystoscopy, 367
  technique of, 369
Cystotomy
  methods of
    perineal, 465
      anatomy in relation to, 465
      bilateral, 472
      complications of, 469
      lateral, 465
      median, 471
      mediobilateral, 473
    suprapubic, 473, 758
      technique of
        for calculus, 473
        for enlarged prostate, 758
Cysts of
  bladder, 500
  Cowper's gland, 273
  kidney, 609
    (see Kidney)
  prostate, 776
  seminal vesicles, 717
  testicle, 672

Dactylitis
  syphilitic, 943, 991
    diagnosis of, 992
    symptoms of, 991
    treatment of, 992
Dermoid cysts
  of testis, 674
Diffuse hydrocele of cord, 695
Ducts, ejaculatory
  anatomy of, 619
  inflammation of, gonorrhœal, 154
    treatment of
      (see Urethritis, gonorrhœal, chronic posterior)
  obstruction of, 804
    treatment of, 804

Ear
  syphilis of
    acquired, 928
    hereditary, 983
Echinococcus
  of kidney, 611
    diagnosis of, 612
    symptoms of, 612
    treatment of, 612
Elephantiasis
  of penis, 60
  of scrotum, 624
Enchondroma
  of testis, 673
Encysted hæmatocele
  of testis, 701
Encysted hydrocele
  of cord, 696
  of epididymis, 669
  of testis, 669
    symptoms of, 672
    treatment of, 673

- Enuresis, 322
  - (see Urine, incontinence of)
  - diagnosis of, 324
  - treatment of, 324
    - mechanical, 325
    - medicinal, 325
- Epididymis
  - anatomy of, 618
  - cysts of, 669
  - inflammation of
    - (see Epididymitis)
  - syphilis of, 664, 960
    - treatment of, 961
  - tuberculosis of, 658
    - (see Epididymo-orchitis)
    - diagnosis of
      - acute, 661
      - chronic, 662–664, 961
    - prognosis of, 662
    - symptoms of
      - acute, 660
      - chronic, 661
    - treatment of
      - palliative, 663
      - radical, 663
- Epididymitis
  - (see Epididymo-orchitis)
  - gonorrhœal, 191, 645
    - clinical course of, 646
    - diagnosis of, 646–647
    - etiology of, 191, 645
    - hydrocele of, 647
    - pathology of, 647
    - prognosis of, 647
    - sterility after, 648
      - treatment of, 802
    - symptoms of, 191, 645
    - treatment of
      - curative, 649
      - prophylactic, 649
  - syphilitic, 960
    - diagnosis of, 960
    - symptoms of, 960
    - treatment of, 960
  - traumatic, 645
  - tubercular, 658
    - diagnosis of, 659–661, 961
    - prognosis of, 662
    - treatment of, 663
  - urethral, 645
- Epididymo-orchitis, 652, 658, 664, 960
  - etiology
    - gout, 654
    - infectious fevers, 652
      - influenza, 655
      - malaria, 654
      - mumps, 652
      - scarlatina, 655
      - tonsillitis, 654
      - typhoid fever, 654
      - variola, 655
    - syphilis, 664, 961
    - traumatism
      - contusion, 642, 655
      - strain, 642
- Epididymo-orchitis, etiology — Continued
    - tuberculosis
      - diagnosis of, 661
      - etiology of, 659
      - prognosis of, 662
      - symptoms of, 660
      - treatment of
        - curative, 663
        - palliative, 663
- Epispadia, 81, 392
  - treatment of
    - operative, 83
    - palliative, 83
      - (see Exstrophy of bladder)
- Epithelial cysts
  - bladder, 500
- Epithelioma
  - bladder, 488
    - diagnosis of, 490
    - prognosis of, 491
    - symptoms of, 489
    - treatment of, 491
  - penis, 64
    - diagnosis of, 65
    - etiology of, 65
    - prognosis of, 66
    - symptoms of, 64
    - treatment of, 66
  - scrotum, 625
- Erection
  - in acute urethritis, 122
  - interference with, after circumcision, 17
  - mechanism of, 777
  - painful, 122
    - treatment of, 129
- Eruptions
  - syphilitic, 859
- Exstrophy of bladder, 392
  - diagnosis of, 392
  - prognosis of, 393
  - treatment of, 393
- Extirpation
  - of bladder, 498
- Eye
  - gonorrhœa of, 194
    - diagnosis of, 195
    - etiology of, 194
    - prognosis of, 196
    - symptoms of, 194
    - treatment of, 196
  - syphilis of
    - choroid, 926
    - ciliary body, 926
    - cornea, 923
    - hereditary, 982
    - iris, 924
    - lachrymal apparatus, 923
    - muscles of, 927
    - optic nerve, 926
    - retina, 926
    - sclera, 924

- FATTY HYDROCELE, 694
- FEVER IN
  - abscess testis, 656
  - acute cystitis, 418
  - epididymitis, 646
  - perinephritis, 582
  - pyelitis, 568
  - pyelonephritis, 574
  - renal tuberculosis, 599
  - retention of urine, 298
  - suppurative nephritis, 578
  - syphilis, 852
  - urethral, 258 (see Urethral fever)
    - prognosis of, 260
    - symptoms of, 260
    - treatment of, 260
  - urethritis, acute
    - female, 170
    - male, 125
- FIBROMA OF
  - bladder, 487
  - kidney, 605
  - penis, 60
  - scrotum, 626
  - testis, 674
- FISTULA
  - renal, 602
    - prognosis of, 602
    - symptoms of, 602
    - treatment of, 602
  - ureteral, 521
  - urethral, 97, 189, 262
  - urethro-penile, 267
    - treatment of, 267
  - urethro-perineo-scrotal, 26
    - diagnosis of, 266
    - etiology of, 265
    - treatment of, 267
  - urethro-rectal, 262
    - diagnosis of, 263
    - etiology of, 262
    - prognosis of, 264
    - symptoms of, 263
    - treatment of, 264
  - vesical, 403, 437
    - diagnosis of, 438
    - symptoms of, 437
    - treatment of, 438
- FOLLICULITIS IN
  - female, 171
    - treatment of, 172
  - male, 188
    - treatment of, 189
- FRÆNUM
  - abnormalities of, 6, 22
  - anatomy of, 2
- FREQUENCY OF URINATION
  - diagnostic significance of, 289
  - etiology
    - bladder
      - calculus of, 443
      - changes in, 227
      - contraction of, 292
        - treatment of, 293
- FREQUENCY OF URINATION, etiology, bladder—Continued
      - foreign body in, 484
      - inflammation of, 416
        - (see Cystitis)
      - tuberculosis of, 431
    - functional, 291
      - treatment of, 292
    - kidney
      - calculus of, 555
      - inflammation of, 568
        - (see Pyelitis)
      - tuberculosis of, 598
    - prostate
      - enlarged, 739, 740
      - inflammation of
        - acute, 726
        - chronic, 730
      - irritable, 732
      - tuberculosis of, 733
    - testis
      - tuberculosis of, 661
    - ureter
      - calculus of, 515
    - urethra
      - inflammation of (gonorrhœal)
        - female, acute, 169
        - male, acute anterior, 120
          - acute posterior, 123
          - chronic posterior, 154
- FUNGUS OR HERNIA OF
  - testis, 657
- FUNICULITIS
  - acute (see Hydrocele, acute)
    - treatment of 704, 705
  - chronic, 705
  - phlegmonous, 705

- GENERAL SYMPTOMATOLOGY OF URINARY DISEASES, 285
- GLEET, 147
  - (see Urethritis)
- GLYCOSURIA, 347
  - causes of, 347
  - diagnosis of, 364
- GONOCOCCUS
  - characteristics of, 114, 118
  - culture of, 114
  - staining of, 115
    - technique of, 116
- GONORRHŒA
  - children, in, 179
      - female, 181
      - male, 179
    - causes of, 182
    - diagnosis and symptoms of, 182
    - prognosis of, 182
    - treatment of, 182
  - definition of, 113
  - etiology of, 113
  - extragenital and systemic, 192
  - inflammation (gonorrhœal) of
    - anus, 193
      - (see Proctitis)

GONORRHŒA, inflammation (gonorrhœal) of—Continued
    Bartholin's gland, 173
      (see Bartholinitis)
    bladder, 192
      (see Cystitis)
    Cowper's gland, 271
      (see Cowperitis)
    endocardium, 202
    epididymis, 191
      (see Epididymitis)
    eye, 194
    glans, 30
      (see Balanitis)
    joints, 198
      (see Rheumatism), 198
    kidney, 192
      (see Nephritis)
    lymphadenitis, 187
    lymphatics, 187
    mouth, 194
    ovaries, 176
    pericardium, 202
    pleura, 202
    prepuce, 30
    prostate, 190
      (see Prostatitis)
    rectum, 193
    seminal vesicles, 191
      (see Seminal vesiculitis)
    tendons, 201
    testicle, 191
    tubes (Fallopian), 176
    ureter, 192
      (see Ureteritis)
    urethra (male), 113
      (see Urethritis)
    uterus, 175
    vagina, 177
      (see Vaginitis)
    veins, 201
      (see Phlebitis)
    vulva, 173
      (see Vulvitis)
  medico-legal diagnosis of, 117, 180, 182
  women, in, 168
    contagion of, 168
    diagnosis of, 169
    symptoms of
      acute, 169
      subacute, 169
    urethritis in, 170
      acute, 170
      chronic, 170
        folliculitis, 171
          diagnosis of, 171
          treatment of, 172

HÆMATOCELE, 699
  acute, 697
    symptoms of, 697
    treatment of, 698
  chronic, 698
    diagnosis of, 699
    differential diagnosis, 699
HÆMATOCELE, chronic—Continued
    prognosis of, 700
    treatment of, 700
  of spermatic cord, 702
  testicular, 701
    treatment of, 701
HÆMATURIA, 329
  causes of, 330, 345
  diagnosis of, 340, 366
  diagnostic significance of, 329, 340
    cystoscope in, 332
    determination of source of, 331
  treatment of, 333
HÆMOGLOBINURIA, 346
  causes of, 346
  diagnosis of, 347
HEADACHE
  syphilitic, 909, 913
HYDRARGYRISM, 1018
  (see Syphilis, treatment of)
HYDROCELE, 677
  acute (vaginalitis), 678
    diagnosis of, 678
    prognosis of, 679
    treatment of, 679
  chronic, 680
    classification of, 680
      bilocular, 690, 693
      congenital, 691
        diagnosis of, 692
        prognosis of, 692
        treatment of, 692
      cord, of the, 695
        diagnosis, 695
        treatment, 695
      double, 699
      encysted, 696
        diagnosis of, 696
        symptoms of, 696
        treatment of, 696
      fatty, 694
      infantile, 693
        treatment of, 693
      inguinal, 694
        treatment of, 694
      tunica vaginalis testis, of, 680
        diagnosis of, 683
        differential diagnosis of, 685
        prognosis of, 685
        symptoms of, 683
        treatment of, 686
          choice of operation for, 690
          indications for operations, 690
HYDRONEPHROSIS, 589
  (see Kidney)
HYPERNEPHROMA, 614
HYPOSPADIA, 73
  (see Urethra, deformities of)

IMPOTENCE
  atonic, 783
    diagnosis of, 787

IMPOTENCE, atonic—Continued
    - prognosis of, 788
    - symptoms of, 786
    - treatment of, 789
  - irritative
    - causes of, 784
    - female, in, 798
  - organic, 779
  - psychic, 781
    - treatment of, 782
  - relative, 782

JOINTS
  - gonorrhœa of, 199
    - diagnosis of, 200
  - syphilis of, 944
    - (see Syphilis)

KIDNEY
  - abscess of, 577
    - perinephritic, 579
  - anatomy of, 524
    - Brodel's studies of, 527
  - anomalies of, 528
  - calculi of, 550
    - diagnosis of, 556, 558
    - differential diagnosis of, 556
    - etiology of, 552
    - pathology of, 550
    - prognosis, 559
    - symptoms of, 554
    - treatment of, 559
      - nephrolithotomy, 560
  - carcinoma of, 604
  - contusions of, 537
    - complications of, 542
    - diagnosis of, 540
    - differential diagnosis of, 541
    - prognosis of, 541
    - symptoms of, 538
    - treatment of, 542
      - nephrectomy in, 543
        - technique of, 547
      - open operation in, 543
  - cysts of, 609
    - agglomerated, 610
    - echinococcus cyst, 611
      - treatment of, 612
    - hydatid, 611
    - pyeloparanephric, 587
    - simple cyst, 609
    - treatment of, 611
  - fistula of, 602
  - floating, 529
  - gonorrhœa of, 192
  - hydronephrosis, 589
    - acquired, 590
      - causes of, 590
    - congenital, 589
    - diagnosis of, 593
    - pathology of, 591
    - prognosis of, 594
    - symptoms of, 594
    - treatment of, 594

KIDNEY—Continued
  - infarct of, 587
  - inflammation of, 565
    - (see Kidney, suppuration of)
  - insufficiency of, 382
    - determination of, 382
      - cryoscopy of, 383
      - dilution test for, 383
      - methylene-blue test for, 383
      - phloridzin test for, 383
    - treatment in presence of, 384
      - surgical treatment of, 385
      - treatment of, 293, 335
  - movable, 530
    - diagnosis of, 531
    - etiology of, 530
    - pathology of, 530
    - prognosis of, 533
    - symptoms of, 530
    - treatment of, 533
      - nephrectomy, 537
      - nephrorrhaphy, 535
        - after-treatment of, 536
        - indications and technique of, 535
  - phlebitis of, 388
  - rupture of, 539
    - complications of, 542
    - diagnosis of, 540
    - differential diagnosis, 541
    - prognosis of, 541
    - symptoms of, 538
    - treatment of, 542
  - sarcoma of, 605
    - (see Kidney, tumors of)
  - suppuration of, 565
    - etiology of, 565
    - nephritis (suppurative), 577
      - cause of, 577
      - diagnosis of, 578
      - symptoms of, 578
      - treatment of, 579
    - perinephritis, 579
      - diagnosis of, 584
      - etiology of, 579
      - pathology of, 579
      - prognosis of, 586
      - symptoms of, 581
      - treatment of, 586
    - pyelitis, 567
      - diagnosis of, 569
      - etiology of, 567
      - gonorrhœal, 191
      - pathology of, 567
      - prognosis of, 569
      - treatment of, 569
    - pyelonephritis, 574
      - diagnosis of, 575
      - differential diagnosis, 576
      - etiology of, 574
      - pathology of, 574
      - symptoms of, 574
      - treatment of, 576
    - pyonephrosis, 570
      - diagnosis, 571

KIDNEY, suppuration of, pyonephrosis—Continued
      differential diagnosis of, 572
      prognosis of, 573
      symptoms of, 571
      treatment of, 572
         nephrectomy, 573
         nephrotomy, 573
            dangers of, 573
  syphilis of, 958
    (see Syphilis)
  tuberculosis of, 596
    acute, 596
    chronic, 596
    diagnosis of, 600
    etiology of, 597
    prognosis of, 601
    symptoms of, 598
    treatment of, 601
  tumors of, 603
    connective-tissue origin, 605
      fibromata, 605
      leucomyomata, 605
      lipomata, 605
      sarcomata, 605
    epithelial origin, 603
      adenomata, 604
      carcinomata, 604
    heterogeneous origin, 606
      rhabdomyomata, 606
      suprarenal origin, 606
    hypernephroma
      pathology of, 614
      symptoms of, 614
      treatment of, 614
    malignant, 606
      diagnosis of, 607
      prognosis of, 608
      symptoms of, 606
      treatment of, 609
    secondary, 606
  vascularization of, 527
    Brödel's demonstration of, 527
  wounds of, 544
    gunshot, 544
    incised, 545
    punctured, 545
      diagnosis of, 545
      prognosis of, 546
      symptoms of, 545
      treatment of, 546

LARYNX
  syphilis of, 934

LEUCOCYTOSIS IN
  renal diseases, 586

LITHOLAPAXY, 452
  complications, 463
  contra-indications to, 462
  in children, 459
  perineal, 457
    indications for, 458
  sequelæ of, 464

LITHOTOMY, 464
    (see Cystotomy)
  perineal, 465
    bilateral, 472
    lateral, 465
      complications of, 469
        after-treatment of, 470
    median, 471
    medio-bilateral, 473
  suprapubic, 474
    after-treatment of, 477
    complications of, 481
    preparation for, 474
    sequelæ, 481

LITHOTRITE
  Bigelow's, 452
  Weis's, 452

LIVER
  syphilis of, 953, 996
    precocious, 953
    tertiary, 953

LUNGS
  syphilis of, 936, 996
    diagnosis, prognosis, and treatment of, 956
    symptoms of, 955

LUXATION
  penis, 26
  testis, 638

LYMPHADENITIS (Bubo)
  carcinomatous, 666
  chancroidal, 42, 43, 47
    etiology of, 48
    prognosis of, 49
    symptoms of, 48
    treatment of, 49, 57
  gonorrhœal, 187
    symptoms of, 187
    treatment of, 187
  inflammatory, 31
  syphilitic, 847
    diagnostic table, 848
    treatment of, 849

LYMPHADENOMA
  testis, 673

LYMPHANGIOMA (see Elephantiasis)
  penis, 60
  scrotum, 624

LYMPHANGITIS
  chancroidal, 47
  gonorrhœal, 29, 187
    treatment of, 29
  inflammatory, 28
    diagnostic table, 848
  syphilitic, 846, 851
    diagnostic table, 848
    treatment of, 849

LYMPHATIC SYSTEM
  syphilis of, 951, 993

MACULES, SYPHILITIC, 861

MAMMARY GLANDS
  syphilis of, 967

- Marriage and syphilis, 973
- Masturbation (Onanism)
  - sequelæ of, 806 et seq.
  - treatment of
    - in adults, 809
    - in children, 808
- Meatotomy
  - female, 257
  - male, 243
- Meatus
  - chancre of, 838
  - stricture of
    - female, 256
    - male, 213
- Mercury in syphilis, 1001
  - (see Syphilis, treatment of)
- Metritis
  - gonorrhœal, 175
- Mouth
  - chancroid of, 39
  - gonorrhœa of, 194
  - syphilis of, 826, 893 et seq.
- Mucous patch, 864
- Muscles
  - syphilis of, 947
- Myositis, syphilitic, 947
  - acute irritative, 947
  - chronic interstitial, 947
  - gummatous, 948

- Nasal cavities
  - syphilis of, 930
- Necrosis
  - syphilitic, 938
  - testicle, 657
- Neoplasms
  - bladder, 485
  - cord, 705
  - Cowper's glands, 273
  - kidney, 603
  - penis, 60
  - prostate, 775
  - scrotum, 625
  - seminal vesicles, 719
  - suprarenal capsules, 613
  - testicle, 665
  - ureter, 523
  - urethra, 269
- Nephralgia, 556
- Nephrectomy, 547
  - technique of
    - abdominal, 548
    - extraperitoneal, 547
- Nephritis
  - gonorrhœal, 192
  - suppurative, 577
    - diagnosis of, 578
    - etiology of, 577
    - symptoms of. 578
    - treatment of, 579
  - syphilitic, 958
- Nephrolithotomy, 560
  - indications for, 560
  - technique of, 560
- Nerves
  - syphilis of, 921, 993
- Nervous system
  - syphilis of, 858, 904
- Neuralgia
  - syphilitic, 853, 909
  - testicular, 703
    - treatment of, 703
- Neurosis
  - genito-urinary or sexual, 786
- Nose
  - syphilis of, 929
- Nymphomania and satyriasis, 811

- Œsophagus
  - syphilis of, 900
- Oligospermia, 801
- Oliguria, 334
  - in contusion of kidney, 538
  - in suppurative nephritis, 577
- Onychia
  - syphilitic, 887
- Orchitis
  - (see Epididymo-orchitis)
  - syphilitic, 961
- Ovaries and tubes
  - gonorrhœa of, 176
  - syphilis of, 966
- Ovaritis, 176
- Oxaluria, 340
  - causes of, 340
  - diagnosis of, 358

- Pain in genito-urinary diseases
  - diagnostic significance of, 285
- Palate
  - syphilis of, 898
- Pancreas
  - syphilis of, 957, 997
- Papular syphilide, 862, 890
- Papulo-squamous syphilide, 866
- Paræsthesia (sexual), 814
- Paraphimosis, 17
  - causes of, 18
  - chancroidal, 46
    - treatment of, 55
  - gonorrhœal, 186
  - treatment of, 18
- Patent urachus, 397
- Penis
  - abscess of, 27
  - adenoma of, 60
  - amputation of
    - accidental, 24
    - partial, 66
    - total, 67

PENIS—Continued
  anatomy of, 1
  angioma of, 60
  anomalies of, 4
  cancer of (epithelioma), 64
    diagnosis, 65
    etiology, 65
    prognosis of, 66
    symptoms of, 64
    treatment of, 66
  cellulitis of, 27
  chancre of, 827
    (see Chancre)
  chancroid of, 36
    (see Chancroid)
  contusion of, 22
  cysts of, 60
  dermatitis of, 26
    of ivy poisoning, 26
    of ruptured urethra, 26
  eczema of, 26
  elephantiasis, 60
      (see Lymphangioma)
    diagnosis of, 61
  epithelioma of, 64
  erysipelas of, 27
    treatment of, 27
  fibroma of, 60
  fracture of, 25
  gangrene of, 27
    treatment of, 27
  gumma of, 885
    diagnosis of, 885
  gunshot wounds of, 24
  herpes progenitalis, 33
    diagnosis of, 34, 834
    treatment of, 35
  horny growths of, 63
  hypertrophy of, 5
  incised wounds of, 22
  inflammation of
    acute, 26
      treatment of, 27
    chronic, 28
      treatment of, 28
  lacerated wounds of, 24
  lymphangitis of, 28
    gonorrhœal, 29
    treatment of, 29
  painful erection of, 122
  papilloma of, 61
    (see Venereal warts)
  phlebitis of, 29, 30
  punctured wound of, 24
  sarcoma of, 60
  syphilis of, 827, 864, 966
      (see Chancre; see Mucous patch)
    gumma of, 885, 965
    relapsing chancre of, 819, 833
  tuberculosis of, 44
  tumors of, 60
  ulcerative lesions of
    chancroidal, 40
      (see Chancroid)
    diagnosis of, 43

PENIS, ulcerative lesions of—Continued
    gangrenous, 27
    herpetic, 34
    inflammatory, 31
      (see Balanitis)
    malignant, 64
    syphilitic, 43
    trophic, 27
    tubercular, 44
  varicose veins of, 30
  venereal warts of (verrucæ), 61
    causes of, 61
    diagnosis of, 62
    symptoms of, 61
    treatment of, 62

PERIOSTITIS
  syphilitic, 939

PERI-URETHRAL ABSCESS, 188

PERI-URETHRAL CRYPTS
  inflammation of, 152

PHAGEDÆNA OR GANGRENE
  chancroidal, 44, 46
    treatment of, 56
  serpiginous, 47
    treatment of, 56
  syphilitic, 830

PHALANGES
  syphilitic dactylitis, 943

PHARYNX
  syphilis of, 899

PHIMOSIS
  acquired, 8
    treatment of, 8
      circumscision, 9
  chancroidal, 44
    treatment of, 46, 54
  complications of, 7
  congenital, 7
  gonorrhœal, 185
    diagnostic table of, 186

PHLEBITIS
  gonorrhœal, 201
  penile, 30, 29
  syphilitic, 951

PHOSPHATURIA, 338, 360
  in cystitis, 416
    diagnosis of, table, 157
  production of, 414

PIGMENTARY SYPHILIDE, 876

POLLUTIONS, 795
  diurnal, 795
  nocturnal, 124, 795
    treatment of, 796

POLYURIA, 334
  in hydronephrosis, 593
  in pyelitis, 568

PREPUCE
  anomalies of, 6
    treatment of, 6, 7
  gumma of, 885

Priapism, 798
- gonorrhœal, 122
  - treatment of, 129

Proctitis
- gonorrhœal, 193
- syphilitic, 901
  - diagnosis of, 903
  - prognosis of, 902
  - symptoms of, 902
  - treatment of, 902

Prostate
- abscess of, 190
  - (see Prostatitis)
- anatomy of, 720
- atrophy of, 773
- calculi of, 773
  - symptoms, diagnosis, and treatment, 774
- cancer (carcinoma) of, 775
  - treatment of, 776
- contusion of, 772
- cysts of, 776
- enlargement or hypertrophy of, 734
  - clinical classification of, 745
  - diagnosis of, 741
  - differential diagnosis of, 744
  - effect on bladder and rectum, 735
  - etiology of, 737
  - pathology of, 736
  - prognosis of, 746
  - symptoms of, 739
  - treatment of
    - palliative, 747
      - catheterization, 749
      - hygienic, 747
      - intermittent dilatation, 748
      - massage, 749
      - medicinal, 748
      - rectal injections, 749
      - stretching internal vesical sphincter, 752
    - radical
      - castration, 769, 772
        - indications for, 751
        - preliminary examination and treatment, 751
      - prostatectomy, 758
        - indications for, 751, 758
        - perineal, 760
          - results of, 768
        - suprapubic, 758
      - prostatotomy, 753
        - galvanocautery, 754
        - indications for, 751
        - knife, perineal route, 753
      - vasectomy, 769, 773
        - indications for, 751
- inflammation of, 190, 724
  - (see Prostatitis)
- irritable, 732
  - diagnosis and treatment of, 732
- neoplasms of
  - carcinoma, 775
    - treatment of, 776

Prostate, neoplasms of—Continued
  - cysts, 776
- syphilis of, 965
- tuberculosis of, 732
  - diagnosis and prognosis of, 734
  - symptoms of, 733
  - treatment of, 734
- wounds of, 723
  - prognosis of, 723
  - treatment of, 724

Prostatectomy, 758
- (see Prostate, enlargement of, treatment of, radical)

Prostatitis
- acute, 190, 724
  - causes of, 724
  - diagnosis of, 727
  - pathology of, 725
  - prognosis of, 727
  - symptoms of, 726
  - treatment of, 728
- chronic, 729
  - causes of, 729
  - pathology of, 729
  - prognosis of, 730
  - symptoms of, 730
  - treatment of, 731
- gonorrhœal, 190
- tubercular, 733

Prostatorrhœa, 792
- causes of, 792
- prognosis of, 792
- symptoms of, 792
- treatment of, 792

Prostatotomy, 753
- (see Prostate, enlargement of, treatment of, radical)

Pseudo-chancre, 820

Pustular syphilide, 871

Pyelitis, 567
- (see Kidney, suppuration of)

Pyelonephritis, 574
- (see Kidney, suppuration of)

Pyuria, 352
- in cystitis, 416
- in pyelitis, 568
- in pyelonephritis, 575
- in pyonephrosis, 571
- in renal calculus, 556
- in renal tuberculosis, 599
- in suppurative nephritis, 578

Rectum and anus
- gonorrhœa of, 193
  - diagnosis of, 193
  - symptoms of, 193
  - treatment of, 193
- syphilis of, 901
  - diagnosis of, 903
  - prognosis of, 902
  - symptoms of, 902
  - treatment of, 903

- RENAL CALCULUS
  - (see Kidney, calculus of)
- RENAL COLIC
  - description of, 515
- RENAL FISTULÆ, 602
  - (see Fistula, renal)
- RHEUMATISM
  - gonorrhœal, 176
  - syphilitic, 944

- SALPINGITIS AND OVARITIS
  - gonorrhœal, 176
    - diagnosis of, 176
- SATYRIASIS AND NYMPHOMANIA, 811
- SCROTUM
  - anatomy of, 615
  - cancer of, 625
  - cysts of, 626
  - deformities of, 620
  - eczema of, 622
  - elephantiasis of, 624
    - diagnosis of, 624
    - etiology of, 624
    - treatment of, 624
  - emphysema of, 621
  - epithelioma of, 625
  - erythema of, 621
  - gangrene of, 623
    - treatment of, 624
  - hydrocele of, 677 (see Hydrocele)
  - injuries of, 620
  - molluscum contagiosum of, 623
  - œdema of, 621
  - pediculosis of, 623
  - pruritus of, 622
  - sebaceous cysts or steatoma of, 623
  - tumors of, 625
    - enchondromata of, 626
    - epithelioma of, 625
      - treatment of, 626
    - fatty tumors of, 626
    - fibromata of, 626
    - gummata of, 626
    - osteomata of, 626
- SEGREGATION OF URINE, 380
- SEMEN
  - characteristics of, 778
- SEMINAL VESICLES
  - abscess of, 713
  - anatomy of, 619
  - anomalies of, 713
  - cancer of, 719
  - concretions in, 717
  - cysts of, 717
  - function of, 712
  - gonorrhœa of, 713
  - inflammation of, 713
  - injuries of, 713
  - malignant disease of, 719
  - syphilis of, 965
  - tuberculosis of, 718
    - diagnosis of, 718
    - treatment of, 719
- SEMINAL VESICULITIS
  - gonorrhœal, 191
    - acute, 713
      - diagnosis, 714
      - prognosis, 715
      - symptoms, 713
    - chronic, 715
      - diagnosis, 715
      - symptoms, 715
      - treatment, 716
  - syphilitic, 965
  - tuberculous, 718
- SEXUAL
  - neuroses, 786
  - psychopathies, 805
    - anæsthesia, 813
    - hyperæsthesia, 805
    - paræsthesia
      - algolagnia, 814
      - androgyny, 817
      - effemination, 817
      - gynandry, 817
      - homosexuality, 815
        - psychic hermaphroditism, 816
        - urnings, 816
      - viraginity, 817
  - strength, 779
    - normal, 779
  - weakness, 777
- SPERMATIC CORD
  - abscess of, 705
  - anatomy of, 619
  - anomalies of, 704
  - contusion of, 704
  - hæmatocele of, 701
  - hydrocele of, 695
    - (see Hydrocele)
  - inflammation of, 704
    - (see Funiculitis)
  - torsion of, 638
  - tuberculosis of, 706
  - tumors of, 705
- SPERMATORRHŒA, 796
  - causes of, 796
  - diagnosis of, 796
  - treatment of, 796
- SPERMATURIA, 357
- STERILITY, 800
  - aspermia in, 800
    - causes of, 800
  - azoöspermia, 801
  - malemission in, 801
  - oligospermia, 800
  - oligozoöspermia, 801
  - treatment of, 802
    - operative, 802
- SUPRARENAL CAPSULES, 613
  - diseases of, 613
  - tumors of, 614
    - (see Kidney, tumors of)
    - hypernephroma, 614
- SYPHILIS
  - acquired, 818

- SYPHILIS, acquired—Continued
  - atypical form of, 819
  - conceptional, 972
  - constitutional, 850
    - symptoms of, 850
      - alopecia, 857
      - alteration of blood, 851
      - eruption of skin and mucous membrane, 854
      - fever, 852
      - lymphatic involvement, 851
      - neuralgia, 853
      - pain, muscular and articular, 853
  - contagion of, 820
    - methods of, 818
  - etiology of, 818
  - immunity against, 819
    - Colles's law, 819
    - Profeta's law, 819
  - incubation of
    - primary, 824
    - secondary, 849
  - insontium, 826
  - intractable, treatment of, 1047
  - marriage in, 973
  - periods of, 823
  - primary incubation cf, 824
  - primary lesion of, 824 (see Chancre)
  - primary lymphatic involvement,846
  - regional syphilitic infections
    - anus and rectum, 901
      - diagnosis of, 903
      - prognosis of, 902
      - symptoms of, 902
      - treatment of, 903
    - arteries, 950
    - bladder, 436, 960
    - bones, 938
      - diagnosis of, 942
      - gummatous, 939
        - osteomyelitis, 939
        - ostitis, 939
        - periostitis, 939
      - osteoperiostitis, 938
        - eburnation, 939
        - osteophytes, 939
      - osteosyphilosis, 942
        - of cranium, 942
        - of phalanges, 943
        - of tibia, 943
        - of vertebræ, 943
    - brain, 904
      - diagnosis of, 915
      - etiology of, 904
      - pathology of, 906
      - prognosis of, 916
      - symptoms of, 909
      - treatment of, 917
    - breast, 967
    - bronchi, 936
    - bursæ, 947
    - circulatory system, 949
    - cranium, 942
    - ear, 928
- SYPHILIS, acquired, regional infections —Continued
  - epididymis, 960
  - erectile bodies of penis, 965
  - extremities, 943
    - dactylitis, 943
  - eye, 923
  - fauces, 900
  - fingers, 943
  - glands, 847
    - (see Lymphadenitis)
  - gums, 898
  - heart, 949
  - intestines, 901
  - joints, 944
    - arthralgia, 944
    - arthritis, 945
      - diagnosis, 946
      - prognosis, 946
      - treatment, 946
    - synovitis, 944
  - kidneys, 958
  - larynx, 934
  - liver, 953
    - diagnosis of, 956
    - symptoms of, 955
    - treatment of, 956
  - lungs, 937
  - lymphatic system, 951
    - diagnosis of, 952
  - mammæ, 967
  - mouth, 893
  - mucous membranes, 857
    - diagnosis of, 893
    - eruption of, 857, 889
  - nasal cavities, 930
  - nerves, 921
  - nose, 929
  - œsophagus, 900
  - ovaries, 966
  - palate, 898
  - pancreas, 957
  - penis
    - erectile bodies of, 965
    - skin of, 819, 833
  - phalanges, 943
  - prostate, 965
  - seminal vesicles, 965
  - skin, 859
    - acne, 872
      - diagnosis, 872
    - alopecia, 887
    - bullæ, 881
    - ecthyma, 861
      - diagnosis of, 862
    - erythema, 861
      - diagnosis of, 862
    - general characteristics of, 854
    - gummatous syphilide, 881
      - diagnosis of, 886
    - impetigo, 873
    - onychia, 887
    - papular syphilide, 862
      - condyloma, 864
        - diagnosis of, 865

SYPHILIS, acquired, regional infections, skin, papular syphilide—Continued
      large, 863
      mucous patch, 864
      small, 862
    papulo-squamous, 866
      diagnosis of, 869
    paronychia, 888
    pigmentary, 876
    pustular, 870
      large acuminated, 872
        diagnosis of, 872
      large flat, 874
        diagnosis of, 875
      small acuminated, 871
      small flat, 872
        diagnosis of, 873
    pustulo-crustaceous, 875
    rupia, 881
    serpiginous, 875
    tubercular, 877
      diagnosis of, 880
      non-ulcerating, 877
      ulcerating, 879
    vesicular, 869
      diagnosis of, 870
  tendons, 948
  testicles, 961
    diagnosis of, 963
  tibia, 943
  tongue, 894
    diagnosis of, 896
  tonsils, 900
  trachea, 836
  ureters, 960
  urethra, 965
  uterus, 966
  vagina, 966
  vas deferens, 965
  veins, 951
  vertebræ, 943
  viscera, 858
    secondary lesions, 858
reinfection with 819
  diagnosis of, 819
secondary period of, 850
secondary period of incubation, 849
skin eruptions of, 859
tertiary period of, 823
treatment of, 1001
  abortive, 1004
    constitutional, 1007
    destruction or excision of chancre, 1005
    summary of views of, 1008
  constitutional, 1009
    continuous, 1011
    interrupted, 1011
    modified expectant, 1011
    systematic, 1012
      baths in, 1034, 1037
      electric baths in, 1040
      heat in, 1036
      hygiene in, 1001

SYPHILIS, acquired, treatment of, constitutional, systematic—Continued
      iodides in, 1016
        indications for, 1018
        iodism in, 1021
          treatment of, 1022
        use of, 1041
      mercury in, 1012
        hypodermic injection of, 1032
          contraindications for 1033
          indications for, 1032
          preparations for, 1033
          technique of, 1028
          value of, 1032
        intravenous injection of, 1044
        inunctions of, 1024
        mouth administration of, 1022
        preparations of, 1012
        ptyalism from, 1014
        signs of reaction to, 1013
        thermal springs in, 1035
        toxic effects from, 1018
          treatment of, 1020
  local, 1047
    of chancre, 1047
      (see Syphilis, acquired, treatment of, abortive)
    of syphilide, 1049
  prophylactic, 1001
  Zittmann's treatment, 1047
    of intractable syphilis, 1047
hereditary, 960, 975
  appearance of child with, 976
  dactylitis in, 991
  diagnosis of, 998
  difference between hereditary and acquired, 975
  early, 998
  heredity of, 969
  prognosis of, 974
  regional infection of
    bones, 988
      diagnosis of, 990
      symptoms of, 988
    brain, 993
      diagnosis of, 995
      late, 994
    ear, 983
    eye, 982
    intestines, 997
    joints, 992
    kidneys, 997
    liver, 996
    lungs, 996
    lymphatics, 993
    mucous membranes, 981
    nails, 980
    nose, 989
    osteochondritis in, 988
    pancreas, 997

SYPHILIS, hereditary, regional infection of—Continued
    skin, 976
        alopecia, 980
        bullæ, 978
        erythema, 977
        gummata, 979
        mucous patch, 977
        onychia, 980
        papular, 977
        pustular, 978
        roseolar, 977
        tubercular, 979
        vesicular, 978
    spinal cord, 995
    spleen, 996
    teeth, 984
  transmission of, 969
    maternal, 969
    mixed, 970
    paternal, 969
    period of, 971
  treatment of, 1052
    child, 1053
    mother, 1053
    prophylactic, 1052
infantile, 971
  direct infection in, 971

TEETH
  effects of hereditary syphilis on, 984

TENOSYNOVITIS
  gonorrhœal, 201
  syphilitic, 948

TESTIS
  abscess of, 656
  anatomy of, 615
  anomalies of, 626
  cancer of, 665
    diagnosis of, 666
    prognosis of, 668
    symptoms of, 666
    treatment of, 668
  contusion of, 639
    symptoms of, 640
    treatment of, 641
  cystoma of, 669
  cysts of, 672
    dermoid, 674
  enchondroma of, 673
  fibroma of, 674
  fusion of, 674
  gangrene of, 657
    (see Penis, gangrene of)
  hæmatocele of, 701
  hernia (fungus) of, 657
  hydrocele of, 669
  inflammation of, 644
    (see Orchitis and Epididymo-orchitis)
  injuries of
    (see Testis, contusion of)
  inversion of, 637
  luxation, 638

TESTIS—Continued
  lymphadenoma of, 673
  myoma of, 675
  myxoma of, 675
  neuralgia of, 703
  osteoma of, 675
  retention of, 629
  sarcoma of, 668
  syphilis of, 664, 961, 997
  tuberculosis of, 658
    diagnosis and symptoms of, 660, 661
    prognosis of, 662
    treatment of, 663
  tumors of, 665
    diagnosis of (table), 963
  wounds of, 643
    treatment of, 644

TONGUE
  chancre of, 841
  syphilis of, 894

TONSILS
  chancre of, 842
  syphilis of, 900

TUBERCULOSIS OF
  bladder, 428
    etiology of, 429
    hæmaturia in, 332
    pathological anatomy of, 431
    prognosis of, 433
    treatment of, 433
  epididymis
    (see Tuberculosis of testis)
  kidney, 596
    diagnosis of, 600, 664, 960
    hæmaturia in, 332
    prognosis of, 601
    treatment of, 601
  prostate, 732
    diagnosis, prognosis, and treatment of, 734
    symptoms of, 733
  seminal vesicles, 718
    diagnosis of, 718
    treatment of, 719
  testis, 658
    diagnosis of, 661
    prognosis of, 662
    symptoms of, 660
    treatment of
      palliative, 663
      radical, 663

TUMORS (see Neoplasms)

TUNICA VAGINALIS
  anatomy of, 677
  hæmatocele of, 697
  hydrocele of, 680
  inflammation of, 678
  loose bodies in, 702

URETER
  anatomy of, 504
  anomalies of, 506

Ureter—Continued
- blocking of, in pyonephrosis, 570
- calculus of, 515
  - diagnosis of, 516
  - differential diagnosis of, 517
  - prognosis of, 518
  - symptoms of, 515
  - treatment of, 518
    - for colic, 518
    - operative, 519
- catheterization of, 379
- cysts of, 523
- fistula of, 521
  - treatment of, 522
- imperforate (congenital) in hydronephrosis, 589
- implantation of, 509, 511
- inflammation of
  - (see Ureteritis)
- injuries of, 507
  - treatment of, 508
- neoplasms of, 523
- palpation of, 512
- prolapse of, 523
- relation of peritoneum to, 506
- rupture of, 507
  - treatment of, 508
- stricture of, 513
  - in hydronephrosis, 590
  - treatment of, 514
- syphilis of, 960
- tuberculosis of, 522
- tumors of
  - (see Neoplasms)
- valve formations of, 507
- wounds of, 507
  - treatment of, 508

Ureteritis
- cystoscopic diagnosis of, 376
- gonorrhœal, 192
- treatment of, 513

Urethra
- abscess of (periurethral), 188
  - treatment of, 189
- anatomy of male, 68
- anomalies of, 71
- appearance of, 277
  - (see Urethra, malformations of)
- calculus of, 99
  - treatment of, 101
- caliber of, 220
- cancer (carcinoma) of, 107
  - treatment of, 108
- caruncles of, 270
- catarrh of
  - (see Urethritis)
- chancre of, 109
- chancroid of, 1011
- congenital stricture of, 72
- curve of, 231
- deformities of, 71
  - (see Urethra, malformations of)
- discharge from
  - affections characterized by, 102

Urethra, discharge from, affections characterized by—Continued
- prostatorrhœa, 792
  - treatment of, 793
- spermatorrhœa, 796
  - treatment of, 796
- urethritis (q. v.), 103
- urethrorrhœa, 102
  - treatment of, 103
- examination (microscopic) of, 117
- source of, 118
- varieties of, 117

Urethra—
- diverticula (pouches) of, 73, 268
- epispadia, 81
  - treatment of, 83
- false passages of, 239
- fistula of, 262
  - urethro-penile, 267
    - treatment of, 267
  - urethro-perineo-scrotal, 265
    - diagnosis of, 266
    - treatment of, 267
  - urethro-rectal, 262
    - diagnosis of, 263
    - treatment of, 264
- foreign bodies in, 95
  - diagnosis of, 96
  - treatment of, 97
- gonorrhœa of
  - (see Urethritis)
- hypospadia, 73
  - treatment of, 77
- inflammation of, 103
  - (see Urethritis)
- injuries of, 89
  - treatment of, 90
- malformations of, 71
- meatus, stricture of, 72
- neoplasms of, 269
- obstruction of, 97
  - treatment of, 97
- papilloma of, 269
- pouches of, 73, 268
  - treatment of, 269
- rupture of, 90
  - diagnosis of, 93
  - etiology of, 90
  - symptoms of, 91
  - treatment of, 93
- stricture of (female)
  - inflammatory, 256
  - organic, 256
  - spasmodic, 256
  - treatment of, 257
- stricture of (male)
  - acquired, 203
  - annular, 208
  - cicatricial, 208
  - clinical forms of, 205
  - diagnosis of, 220
  - impermeable, 209
  - inflammatory, 203
  - irritable, 209
  - linear, 208
  - location of, 211

- Urethra, stricture of—Continued
    - organic, 205
      - treatment of, 228
        - dilatation
          - continuous, 241
          - gradual, 228 (et seq.)
        - perineal section, 251
          - indications for, 252
        - retrograde catheterization, 253
        - urethrotomy, 241
          - combined internal and external, 250
          - external perineal, 247
            - indications for, 249
            - prognosis of, 250
          - internal, 242
            - indications for, 243
          - miscellaneous methods, 254
          - summary of treatment, 255
    - pathology of, 213
    - permeable, 209
    - prognosis of, 227
    - resilient, 209
    - results of, 223
      - on bladder, 227
      - on kidneys, 227
      - on ureters, 227
      - on urine, 223
        - (see Extravasation)
    - retention of urine from, 320
      - treatment of, 321
    - simple, 209
    - soft or recurrent, 208
    - spasmodic, 204
      - treatment of, 205
    - summary of treatment of, 255
    - symptoms of, 216
    - tortuous, 208
    - traumatic, 207
    - treatment of
      - (see Urethra, stricture of, organic)
  - syphilis of
    - (see Urethritis)
  - tuberculosis of, 111
    - treatment of, 112
  - tumors of (see Neoplasms)
- Urethral fever, 258
  - acute, 259
  - chronic, 260
  - etiology of, 258
  - prognosis of, 260
  - symptoms of, 259
  - treatment of
    - curative, 261
    - prophylactic, 261
- Urethral instruments
  - care of, 279
  - sterilization of, 280 (et seq.)
- Urethritis
  - chancroidal, 111
  - classification of, 102
  - concomitant, 108
  - diphtheritic, 113
  - eruptive, 107
- Urethritis—Continued
  - etiology of, 103
  - gonorrhœal (female), 168
    - acute, 170
      - diagnosis of, 171
      - prognosis of, 171
      - symptoms of, 170
      - treatment of, 172
    - chronic, 170
      - treatment of, 172
    - complications of
      - bartholinitis, 173
      - metritis, 175
      - oöphoritis, 176
      - perimetritis, 176
      - vaginitis, 177
      - vulvitis, 173
    - contagion of, 168
    - diagnosis of, 169
    - frequency of, 168
    - symptoms of, 169
  - gonorrhœal (male), 113
    - acute
      - incubation of, 119
      - prognosis of, 125
      - symptoms of
        - inflammatory, 120 (et seq.)
        - prodromal, 119
      - treatment of
        - acute anterior
          - abortive, 126
          - curative, 128
          - prophylactic, 126
        - acute posterior, 143
    - children, in, 179
    - chronic (gleet), 147
      - diagnosis of, 149
      - etiology of, 147
      - pathology of, 147
    - chronic anterior, 150
      - diagnosis of, 151
      - prognosis of, 152
      - symptoms of, 151
      - treatment of, 152
    - chronic posterior, 154
      - diagnosis of, 155
      - prognosis of, 156
      - symptoms of, 154
      - treatment of, 156
    - clinical forms of
      - acute, 119
      - chronic, 147
      - intractable, 167
      - mild, 166
      - neurotic or neuralgic, 166
      - relapsing or recurrent, 167
      - subacute or catarrhal, 147
      - virulent (Russian clap), 166
    - complications, 184
      - balanitis, 184
      - balanoposthitis, 184
      - cystitis, 192
      - epididymitis, 191
      - follicular abscess, 188
        - treatment of, 189

- URETHRITIS, gonorrhœal (male), complications—Continued
      - lymphadenitis (bubo), 187
      - lymphangitis, 187
      - nephritis, 192
      - paraphimosis, 186
      - periurethral abscess, 188
        - treatment of, 189
      - phimosis, 185
      - prostatitis, 190
      - pyelitis, 192
      - rectal inflammation, 193
      - ureteritis, 192
      - vesiculitis, 191
    - diagnosis of, 115, 157
    - etiology of, 113
    - pathology of, 118
  - influenzal, 113
  - irritative, 105
    - diathetic, 106
    - erethismic, 106
    - ingestive, 105
  - mechanical, 107
  - pathology of, 103
  - pneumonic, 113
  - pyogenic, 108
  - symptoms of, 104
  - syphilitic, 109, 965
    - chancre, 109
    - mucous patches, 110
    - tertiary, 111
  - traumatic, 104
  - tubercular, 111
  - typhoidal, 112

- URETHROSCOPY (endoscopy), 273
  - appearance of urethra, 277
  - instruments for, 274
  - technique, 274

- URETHROTOMY, 241
  - combined external and internal, 250
  - external perineal, 247
    - indications for, 249
    - prognosis of, 250
    - with guide (Symes), 247
    - without guide (perineal section). 251
      - indications for, 252
  - internal, 242
    - indications for, 243

- URINE
  - abnormal substances in
    - air (pneumaturia), 350
    - albumen (serum-albumen), 342
    - albumoses, 344
    - bacteriuria, 350
    - biliary pigments (choluria), 348
    - blood (hæmaturia), 345
    - carbohydrates, 347
    - chyle (chyluria), 349
    - cystin, 348
    - diacetic acid, 349
    - fat (lipuria), 349
    - globulin, 344

- URINE, abnormal substances in—Continued
    - hæmoglobin (hæmoglobinuria), 346
    - sugars, 347
  - alterations in
    - color, 335
    - normal substances
      - acetone, 341
      - carbonates, 338
      - chlorides, 336
      - hæmatoporphyrin, 341
      - oxalic acid, 340
      - phosphates, 338
      - sulphur, 337
      - urea, 339
      - uric acid, 339
      - urobilin, 341
    - quantity, 334
    - reaction, 336
    - specific gravity, 335
  - examination for
    - albumen, 361
    - albumose, 363
    - bile pigment, 366
    - blood-coloring matter, 366
    - Ehrlich's diazo reaction, 366
    - indican, 365
    - specific gravity, 360
    - sugar, 364
  - extravasation of, 223
    - causes of, 92, 223
    - prognosis of, 225
    - symptoms of, 223
    - treatment of, 226
  - incontinence of
    - causes of (table), 322
    - children, in, 323
      - diagnosis of, 324
      - treatment of, 324
        - mechanical, 325
        - medical, 324
    - epileptic, 323
    - lesions of urinary tract as cause of, 327
  - retention of, 294
    - causes of, 294, 299, 322
    - congestive, 301
    - effects of, 297
    - incomplete, 317
    - inflammatory, 301
    - obstructive, 302
    - paretic, 300
    - prostatic enlargement, in, 304
      - diagnosis of, 307
      - symptoms of, 306
      - treatment of, 307
    - stricture, in, 320
      - treatment of, 321
    - symptoms of, 294
    - traumatic, 323
  - sediments in
    - crystalline
      - in acid urine, 358
      - in alkaline urine, 360

URINE, sediments in—Continued
    non-crystalline
        bacteria, 355
            gonococcus, 354
            tubercle bacillis, 353
        blood, 351
        casts, 356
        epithelium, 354
        parasites, 355
        pus, 352
        spermatozoa, 357
        tissue, 355
    segregation of, 380
    suppression of, 293, 335
        non-obstructive, 293
        obstructive, 293
            treatment of, 294

UTERUS
    gonorrhœa of, 175
    syphilis of, 966

VAGINITIS, 177
    gonorrhœal, 177
        symptoms and diagnosis of, 178
        treatment of, 178

VAGINITIS—Continued
    syphilitic, 967

VARICOCELE, 707
    etiology of, 707
    prognosis of, 708
    symptoms of, 708
    treatment of, 709

VAS DEFERENS
    anastomosis of, 802
    anatomy of, 618
    concretions of, 717
    excision of, 773
    syphilis of, 965

VEGETATIONS (syphilitic), 865

VENEREAL WARTS, 61

VESICULAR SYPHILIDE, 869

VIRAGINITY, 817

VULVITIS, 173
    treatment of, 173

VULVO-VAGINITIS
    catarrhal, 181
    gonorrhœal, 182

HC 1GVZ Q

17.A.84.
Genito-urinary surgery and vene1906
Countway Library BEI5953
3 2044 045 804 028

17.A.84.
Genito-urinary surg
Countway Library
3 2044 0